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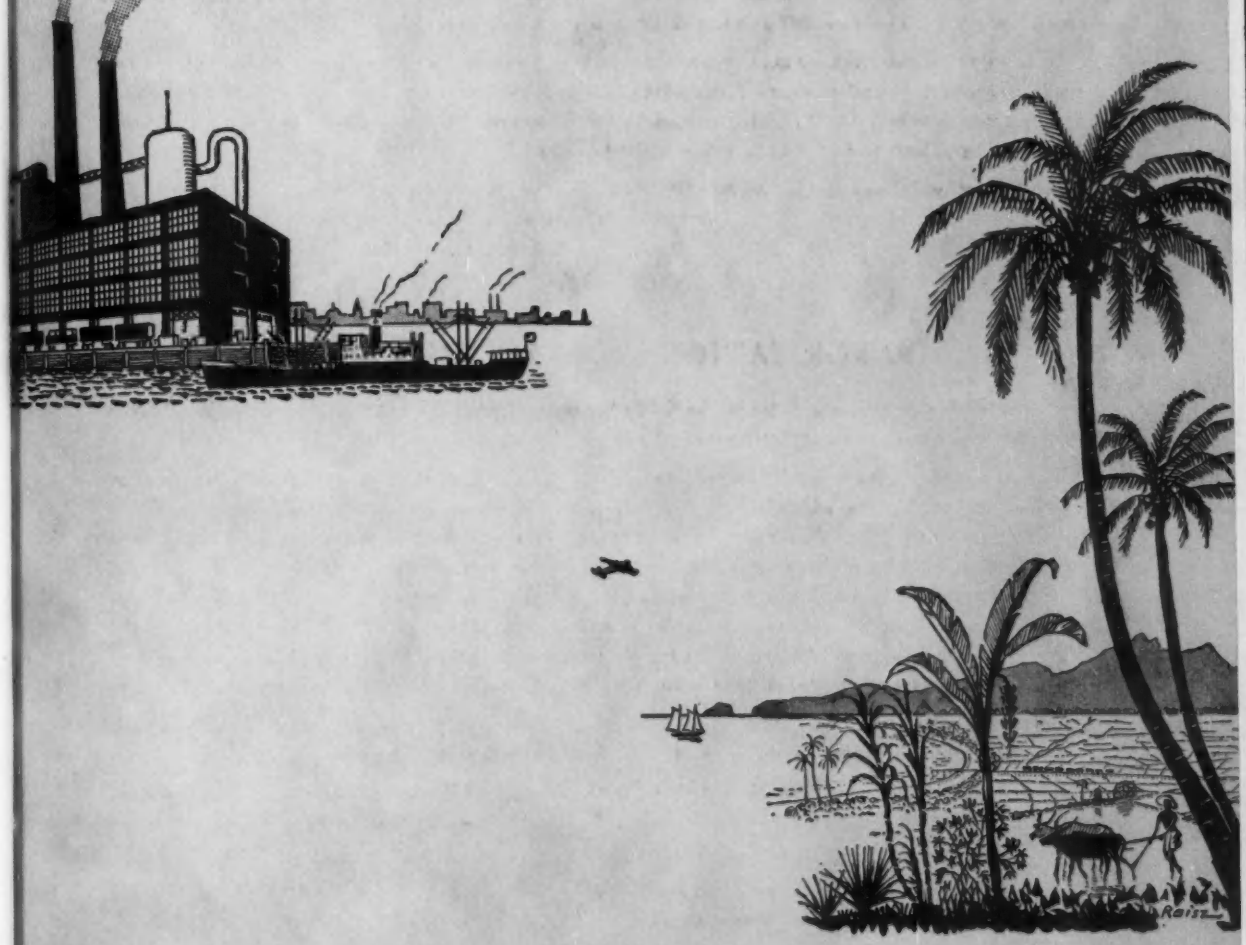
ECONOMIC GEOGRAPHY



Clark University — Worcester, Mass., U.S.A.

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This magazine publishes articles in the field of economic geography as well as articles in adjacent fields that contribute to an understanding of the world's economic patterns.

Authors are requested to send with each article a statement as to the field work, special experience, or other background on which the article is based. They are also urged whenever possible to submit maps and graphs in such form that they can be reproduced directly. In cases where it is necessary these will be redrawn at the editorial offices, but this may result in delay in publication. Delay will be avoided, also, if the author will send a caption with each illustration. All map or chart captions should show the source of data or other information unless this is already given in the illustrations. The sources of information for all tables, too, should be shown. Wherever a photograph is used that was not taken by the author, some source credit should appear in the caption.

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THE INTERNATIONAL GEOGRAPHICAL CONGRESS

For the world's geographers, 1952 is an important year, since it is the occasion of the quadrennial meetings of the International Geographical Union. The sessions will be held in Washington, D.C., August 8–15.

Geographers from many countries will participate in the program of the Seventeenth International Geographical Congress to be held in conjunction with the Assembly of the International Geographical Union. There will be sectional meetings for the presentation of papers in the various fields of geography, general sessions for the discussion of special geographic topics of world-wide interest, and reports on research accomplished by the Commissions appointed by the Union. Geographers from all over the world will have an opportunity to join in the free exchange of ideas and the discussion of lines of investigation which can be furthered by international cooperation. To round out the offerings, a number of excursions will be conducted before and after the Congress meetings.

The staff of ECONOMIC GEOGRAPHY urges geographers from everywhere to attend the Washington meetings and to take part in the excursions. You are most welcome, and we hope that the occasion will be one to which you will look back with pleasure for many years.

Inquiries regarding the meetings should be addressed to the Chairman, USA National Committee, IGU, National Research Council, 2101 Constitution Avenue, Washington 25, D.C.

ECONOMIC GEOGRAPHY

VOL. 28 APRIL, 1952 No. 2

THE DEFINITION OF STANDARD METROPOLITAN AREAS*

Robert C. Klove

Dr. Klove is Assistant Chief, Geography Division, United States Bureau of the Census. This is the first of several articles to appear in this magazine in which he will discuss certain phases of the Census work of interest to economic and urban geographers.

As background for evaluating the definition of standard metropolitan areas, it is well to consider the approach to the problem of defining areas for statistical purposes that is followed by Federal agencies, as this approach has been developing over recent decades and particularly in the years preceding the 1950 Census. For the first hundred years of our national existence, statistics were presented for political divisions of the country and almost for them alone. Around the turn of the century it was recognized that statistics for certain nonpolitical areas or special groups of political units might be more useful for certain purposes. The Bureau of the Census, the major statistical agency of the Federal Government, took the initiative in promoting new types of areas such as Census tracts, industrial areas, and metropolitan districts.

The Census Bureau was not the only Federal agency interested in statistical areas, and increasingly in recent years other agencies have taken part in defining special areas. Almost from the beginning local interests also were brought into the picture to assist in determining criteria and defining areas and in some cases, as, for example, Census tracts, even given the lead in area delimitation. The increasing participation of other agencies and local interests in the definition of statistical areas, it is believed, is making for greater usefulness of the resulting data.

Following the democratic procedure increases the problem of determining criteria for definitions and applying these criteria. Decisions cannot always be unanimous and the majority rule generally has been observed. It has also been a principle as far as possible to adopt uniform area criteria for the entire country so that data for particular types of areas may be comparable from one part of the country to the other. Statistical areas for government use are designed to satisfy the greatest number of users, and the success of the definitions must be measured in terms of the magnitude of their local acceptance and the minimum local dissatisfaction. Furthermore, it is recognized that statistical areas are subject to a process of change. Not only may the areas change, but the uses of area statistics develop in novel ways. New definition criteria are evolved and new sources of data make

*This article is a revision of a paper given by the author at the annual meeting of the Association of American Geographers at Chicago in March, 1951.

possible refinements in the application of the criteria. The purpose of this paper is to show the current status of the metropolitan area definitions.

Standard metropolitan areas have been defined for 172 metropolitan centers in the United States and its territories and possessions by a Federal interagency committee under the direction of the United States Bureau of the Budget. These areas are designated as *standard* because the Federal statistical agencies represented on the committee have agreed to use these areas insofar as it is feasible. In the Bureau of the Census the standard metropolitan areas are replacing the metropolitan districts, the metropolitan counties, and the industrial areas and are being used for the presentation of statistics of population, housing, manufacturing, and business.

CRITERIA AND DEFINITION PROCEDURES

Each of the new standard metropolitan areas, except in New England, consists of one or more entire counties. While it is recognized that metropolitan areas could be defined more accurately by using minor civil divisions, which were the building blocks of the old metropolitan districts, experience has shown that areas so defined have a limited value, because many types of data with which comparisons are desired are available only on a county basis. In New England, where towns rather than counties are commonly the basic geographic units for statistical compilations, this objection applies to a much lesser degree; and mainly for this reason the New England standard metropolitan areas are defined on a town rather than a county basis.

Each standard metropolitan area includes a city with 50,000 inhabitants or more in 1950 and may include more than one city of such size. Conversely, each city of such size is included in a standard metropolitan area. The county in which the city of 50,000 or more is located is by definition in the standard metropolitan area. Contiguous counties may be included in the area if they meet certain criteria. The general concept adopted is one of an integrated economic area with a large volume of daily travel and communication between the central city or cities and the outlying parts of the area. This normally results in an area considerably more restricted, especially for the larger cities, than the market or trading area. The following principles were used in determining the eligibility of contiguous counties for inclusion in the standard metropolitan area:

1. Each county must have 10,000 nonagricultural workers, or 10 per cent of the nonagricultural workers in the standard metropolitan area, or more than half of its population residing in contiguous minor civil divisions with a population density of 150 or more per square mile.
2. Each county must have at least two-thirds of its total employed labor force engaged in nonagricultural work.
3. Each county must be economically and socially integrated with the county containing the largest city in the standard metropolitan area. A county is regarded as integrated (a) if 15 per cent or more of the workers living in the county work in the county containing the largest city, or (b) if 25 per cent or more of those working in the county live in the county containing the largest city, or (c) if telephone calls from the county to the county containing the largest city average four or more calls per subscriber per month.

In New England, where the city and town rather than the county were used to define standard metropolitan areas, the first and second

criteria just mentioned do not apply. In their place, a population density criterion of 150 or more persons per square mile, or 100 or more persons where strong integration is evident, is used.

The Federal Committee on Standard Metropolitan Areas was set up by the Bureau of the Budget late in 1947 with representatives from the following agencies: the Bureau of the Census, the Bureau of Foreign and Domestic Commerce, the Bureau of Labor Statistics, the Federal Security Agency, the Bureau of Employment Security, the Housing and Home Finance Agency, the Federal Housing Administration, the Federal Reserve Board, and the Bureau of Agricultural Economics. After approving the general principles to be followed, the Committee requested the Census Bureau to prepare tentative definitions of individual areas. This work was done by a Census Bureau committee, of which the writer was a member, with the active participation of representatives of the Bureau of the Budget and the Bureau of Employment Security and in the later stages with the help of the Bureau of Labor Statistics. These tentative definitions were discussed with interested local organizations by the Bureau of the Budget or its designated representatives. This local review confirmed the tentative definitions in a large majority of the areas. After reconsidering the definitions in the light of information contained in the field reports, the Census Bureau committee prepared final definitions for submission to the Federal Committee.

PROBLEMS OF DEFINITION

The problems encountered by the Federal Committee and its technical subcommittee may be illustrative of the more general problem of area definition, and also serve to emphasize the difficulties faced in achieving a set of areas comparable over the United States and satisfactory for presenting a wide variety of data. The problems are discussed briefly under three headings:

1. The determination of the criteria
2. The application of the criteria
3. Outside pressure for exceptions to the criteria.

Determination of the Criteria

Reasons already have been given for the acceptance of the county as the basic unit for defining the standard metropolitan areas. It was recognized that the inclusion of whole counties generally results in the inclusion in the metropolitan area of much territory which ordinarily is not considered "metropolitan." Since the population of this territory in almost all cases is negligible relative to the total population of the area, its inclusion is of very minor significance for the presentation of economic and demographic statistics.

The requirement that a standard metropolitan area have a city with a population of 50,000 or more is an arbitrary rule. There is nothing magic about exceeding 50,000 that changes the character of a city. A city of 100,000 or a total area population of 100,000 might be more accurate if we knew exactly what "metropolitan" means. However, a very definite rule in terms of population numbers is necessary, and the public has accepted a city population of 50,000 as a mark of metropolitanism. It is a carry-over of the old metropolitan district definition.

The nonagricultural workers criterion is an attempt to measure metropolitan character in terms of either the absolute or the proportionate size of the manufacturing, commercial, and other nonagricultural portions of the labor force.

The rule acts to exclude predominantly rural counties. Population density is a similar measure and was almost the single criterion of the extent of the old metropolitan districts. It was retained as one of the measures of metropolitan character in defining the new standard metropolitan areas.

The general requirement that each county in an area must have close economic and social integration with the central city or cities appears to require no defense. The specific rules covering commuting and telephone communication adopted by the Committee for demonstrating this integration are subject to question partly because they are empirical, but a more serious objection is the deficiency of adequate data for applying these criteria. They were selected because it appeared that some data along these lines could be secured for most areas.

Application of the Criteria

For the purpose of illustration let us assume that we have joined the Committee while it is defining the Evansville

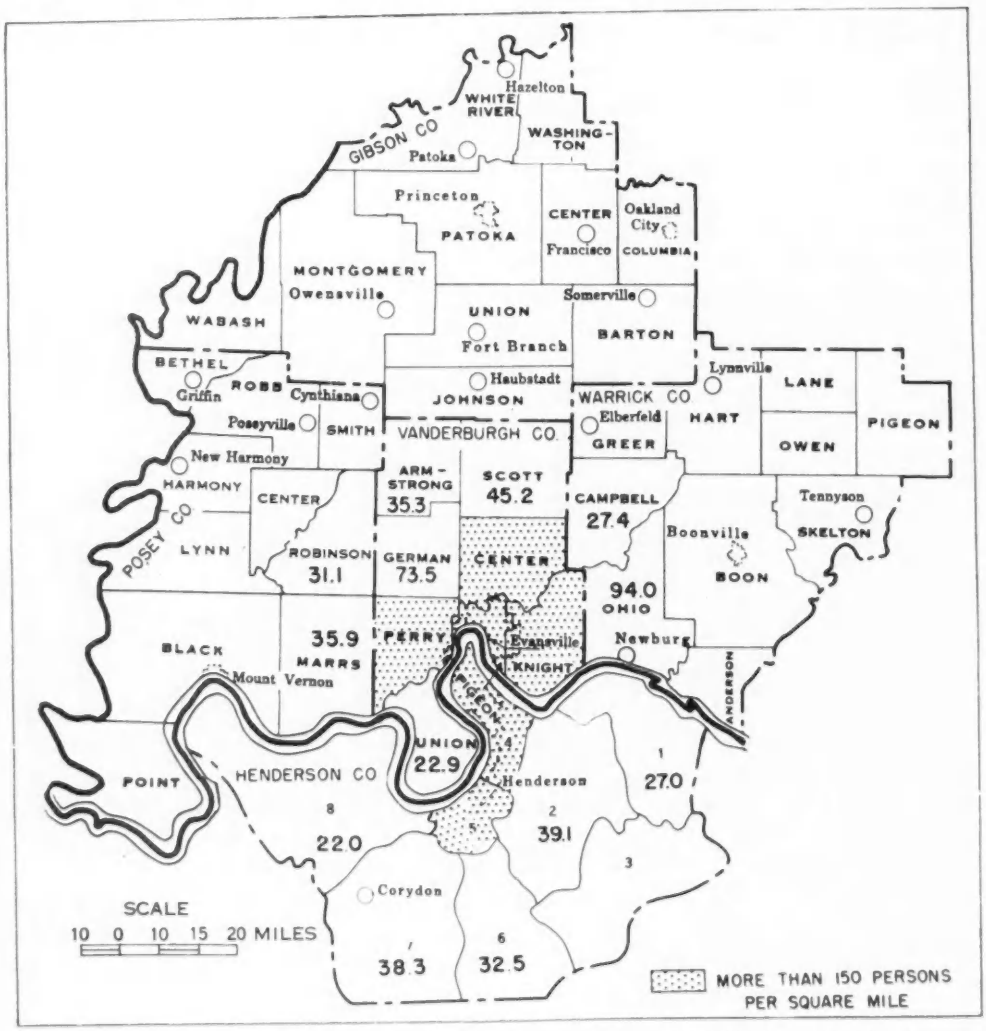

FIG. 1. Evansville and vicinity, population density per square mile, 1950, for selected minor civil divisions.

Standard Metropolitan Area. Evansville is located in southern Indiana on the banks of the Ohio River (Fig. 1). Evansville had a 1940 population of 97,062, so it qualifies for metropolitan area consideration. (The 1950 Census gave it 128,636, so it still qualifies.) No city with a population of 50,000 or more is close to Evansville, so there can be no question that Evansville stands alone as a metropolitan center.

Evansville is in Vanderburgh County, Indiana, which by definition qualifies for inclusion in its standard metropolitan area. Counties contiguous to Vanderburgh which are additional candidates for the standard metropolitan area are Posey, Gibson, and Warrick in Indiana, and Henderson in Kentucky. Each county has less than 10,000 nonagricultural workers according to the latest figures from the Old Age and Survivor Insurance program as collected by the Social Security Administration. Each county also has less than 10 per cent of the nonagricultural employment of Vanderburgh County so obviously would have less than 10 per cent of the nonagricultural employment of any combination of counties selected for the Evansville Standard Metropolitan Area. Contiguous minor civil divisions adjoining Evansville and Vanderburgh County which have a population density of 150 persons or over per square mile are found only in Henderson County, Kentucky. Here, Magisterial Districts 4 and 5 had a population of 27,020 inhabitants in 1940 or 53.8 per cent of the county's population. Therefore, Henderson County, alone, meets the first criteria which requires a county to have 10,000 nonagricultural workers or 10 per cent of the nonagricultural workers in the standard metropolitan area, or more than half of its population in contiguous minor civil divisions with a population density of 150 or more per square mile.

Henderson County, however, fails to meet the second criteria with less than two-thirds of its total labor force in nonagricultural employment. It has only 64.7 per cent. This is a close miss, and it might be the case when later Census data become available that Henderson County would show better than two-thirds of its labor force in nonagricultural employment, so it is decided to investigate the social and economic integration of Henderson County with Vanderburgh County. All the other counties have failed to meet the two so-called "screening" criteria so they are no longer given consideration.

Obtaining data to support or deny economic and social integration between counties proved to be difficult. Much of the information on commuting or place of work and place of residence was supplied by the United States Employment Service through its connections with the State employment security agencies and their local labor market analysts. However, much of these data were spotty in distribution, incomplete, and not strictly comparable from one area to another. An example of unusually good data of this type is a survey of "Indiana Commuting Patterns" made in 1947 by the State Employment Service. The accompanying map (Fig. 2) shows that 2.7 per cent of the Evansville employed live in Henderson County, Kentucky. This is approximately 1500 workers or about 10 per cent of the total employment in Henderson County. It is below the 15 per cent required. No quantitative data on the percentage of workers in Henderson County living in Vanderburgh County was found, but the local labor market analyst is certain that the figure is less than 25 per cent.

Telephone data reveal not more than three calls per subscriber per month from the Henderson exchange area to Evansville, which is less than the four

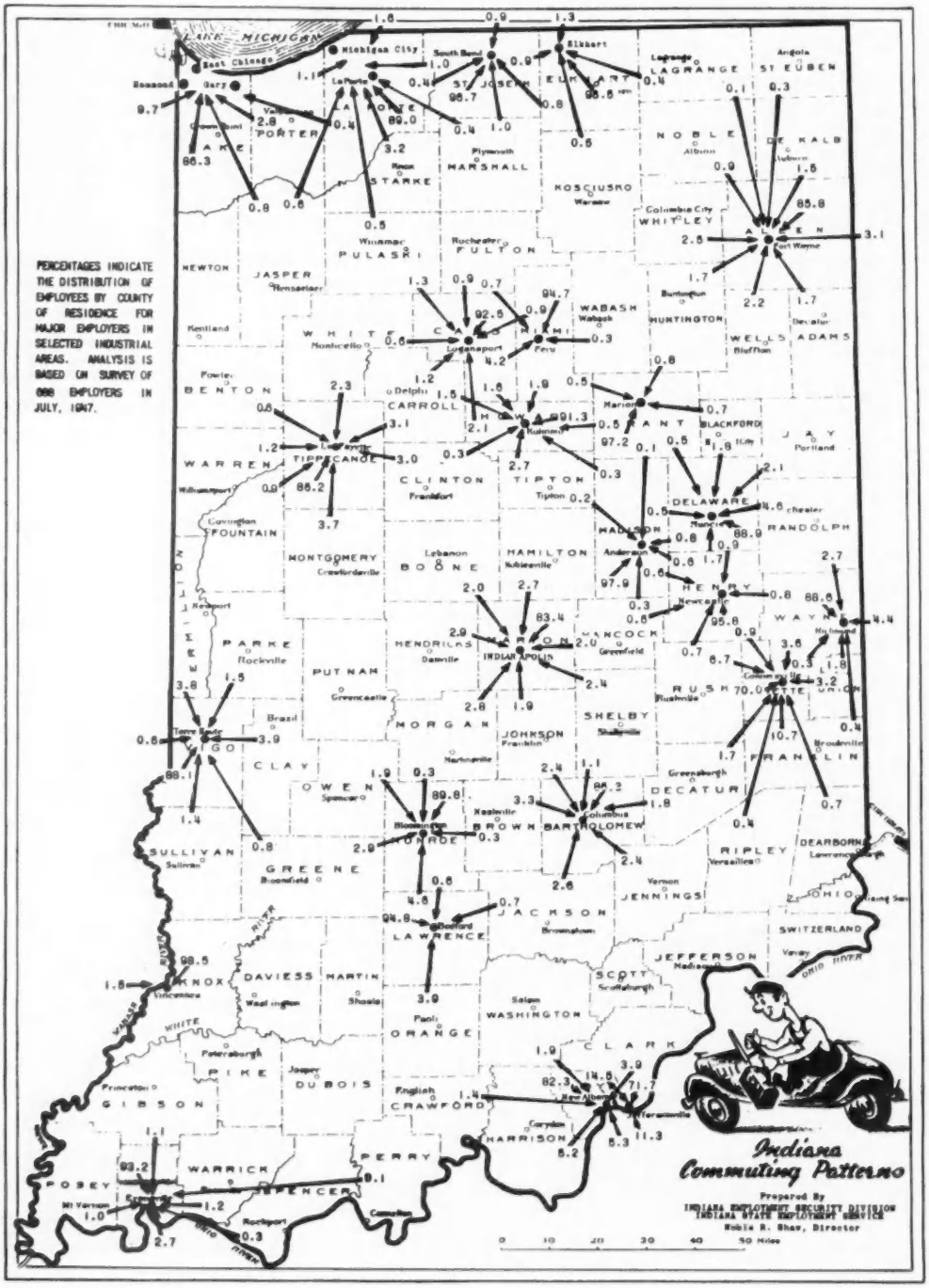
PERCENTAGES INDICATE THE DISTRIBUTION OF EMPLOYEES BY COUNTY OF RESIDENCE FOR MAJOR EMPLOYERS IN SELECTED INDUSTRIAL AREAS. ANALYSIS IS BASED ON SURVEY OF 888 EMPLOYERS IN JULY, 1947.
LAKE MICHIGAN
Indiana Commuting Patterns
Prepared By
INDIANA EMPLOYMENT SECURITY DIVISION
INDIANA STATE EMPLOYMENT SERVICE
Noble R. Shaw, Director
0 10 20 30 40 50 Miles

FIG. 2. Indiana commuting patterns from *The Labor Market*, December, 1947, periodical published by the U. S. Department of Labor, pp. 9–11.

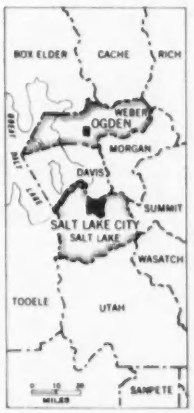

FIG. 3. New York–Northeastern New Jersey Standard Metropolitan Area.
FIG. 4 (lower left). Philadelphia Standard Metropolitan Area.
FIG. 5 (lower center). Ogden and Salt Lake City Standard Metropolitan Areas.
FIG. 6 (lower right). San Francisco–Oakland Standard Metropolitan Area.

calls required. Accordingly Henderson County is submarginal in its integration with Evansville and Vanderburgh County and so is excluded from the Evansville Standard Metropolitan Area which is defined to consist only of Vanderburgh County.

The most frequently encountered problem of definition is the inclusion or exclusion of contiguous peripheral counties which we have already observed in the case of Evansville. Several other examples of counties which gave the Committee trouble are here cited to illustrate the variance of conditions.

Monmouth County, New Jersey, was excluded from the New York–Northeastern New Jersey Metropolitan Area,

although it met both the nonagricultural workers and population density requirements, on the grounds that its economic and social integration with New York City, Newark, and Jersey City was insufficient (Fig. 3). Monmouth County, you will recall, lies along the Atlantic coast south of Lower New York Bay and contains a chain of seaside resort communities which owe their existence largely to their closeness to the New York urban center. However, most of these places are over 50 miles from Manhattan and daily commuting and telephone communication are not strong. Other examples may be taken from the San Francisco–Oakland Metropolitan Area (Fig. 6). Marin County lying north of the San Francisco Golden Gate met the screening criteria and was included in the area despite its relatively low population density, because the population there has very close daily commuting ties with San Francisco. Sonoma and Napa Counties, north of San Francisco Bay, were excluded for failing to meet the screening criteria. Solano County to the northeast of the Bay met the population density criterion and despite its distance from the central cities was demonstrated to have the minimum integration.

"Split" counties constituted another problem which somewhat to our surprise was found very infrequently. A "split county" is defined here as a county lying between two metropolitan centers and possessing substantial integration with each one. Bucks County, Pennsylvania, is an example which has slight penetration from both Trenton and Allentown–Bethlehem but is predominantly oriented towards Philadelphia (Fig. 4). The outstanding example is Davis County, Utah, located between the Salt Lake and Ogden Metropolitan Areas (Fig. 5). On the basis of both commuting and telephone data the county is almost evenly divided between the two centers. The decision was to exclude the county from both areas rather than split it and make it impossible to secure statistical data in some fields for these two metropolitan areas.

A more difficult and more frequently met problem was that of competing cities. In the past, metropolitan cities in adjoining counties were in numerous cases included together in one hyphenated metropolitan district as, for example, Scranton–Wilkes-Barre. In defining the new metropolitan areas these combinations as well as others were examined to determine whether integration existed, using the same principles followed for peripheral counties. Integration was demonstrated to be lacking for the following centers which previously had been combined: Scranton and Wilkes-Barre, Boston and Brockton, Lowell and Lawrence and Haverhill, Fall River and New Bedford, Hartford and New Britain, Norfolk–Portsmouth and Newport News, and Racine and Kenosha.

Outside Pressure for Exceptions to the Criteria

The Committee, following its field review of the tentative metropolitan area definitions, was asked by local groups to change some of the definitions. In many cases the review resulted in supplying to the Committee additional information on population growth in certain areas, decline in agriculture, increase in industrial employment, and evidence of integration or lack of integration between counties. In some cases the Committee was urged to make exceptions to the criteria in defining an individual metropolitan area on the grounds that local or regional conditions are unique and require special rules.

In all instances the Committee, in reaching a decision on the definition of

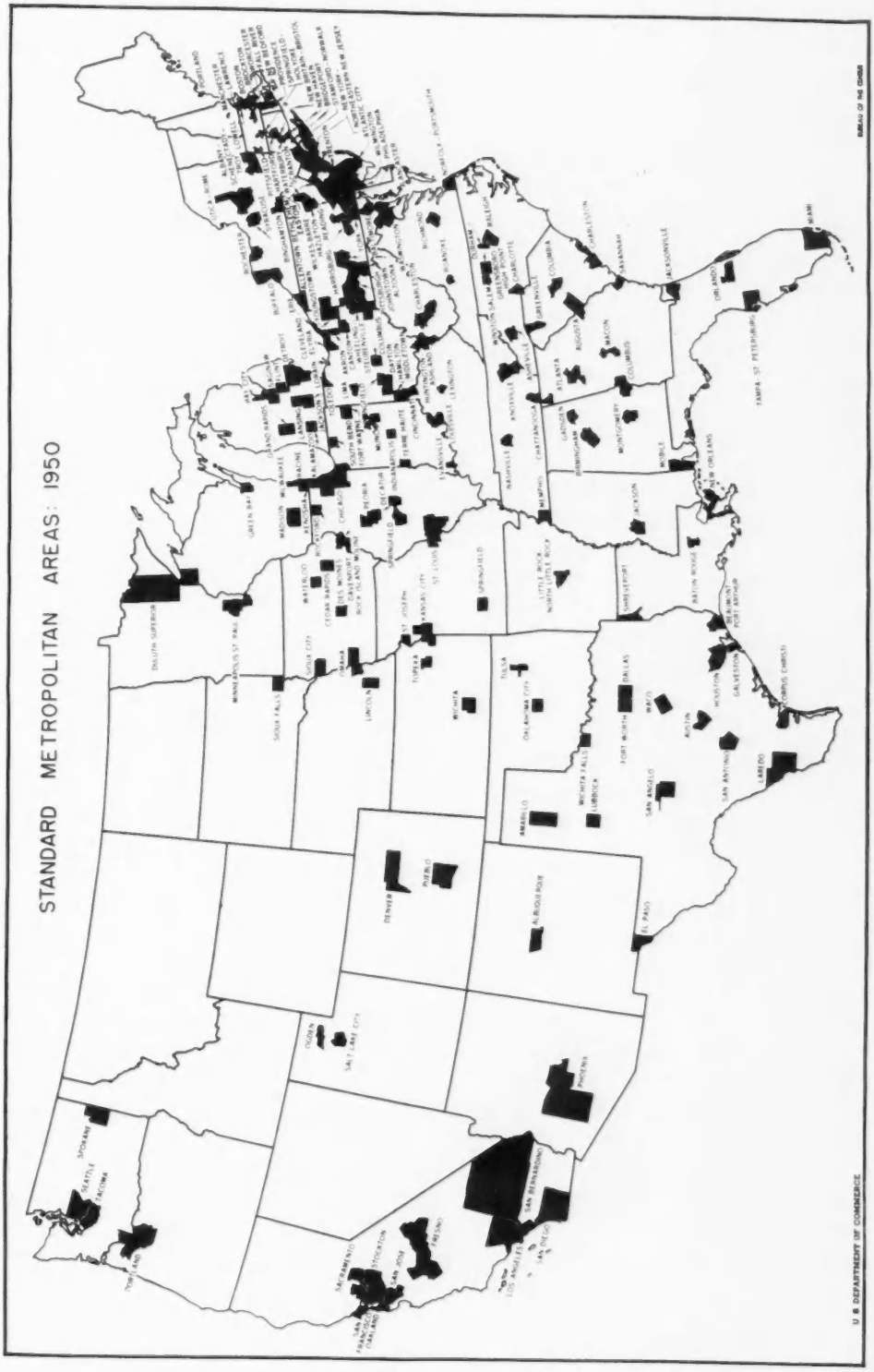

FIG. 7. The 168 Standard Metropolitan Areas of the United States in 1950.

an area, attempted to apply the criteria without making any exceptions. Naturally not all interests could be satisfied, and in part this was due to the fact that the evidence was not conclusive one way or the other, and close decisions had to be made.

The problem of defining metropolitan areas or regions appears to have received little attention from geographers as revealed in publications, and in only a few instances did geographic studies provide data of either a quantitative or a qualitative nature that would aid in the definitions. Here is a field of inquiry that I believe is worthy of more study by geographers because if they can contribute to the definition of a better set of metropolitan areas the data provided for these areas by government surveys will be more useful for the further analysis of metropolitan problems and the attainment of sound conclusions.

CULTURAL DICHOTOMY IN THE ISLAND OF HISPANIOLA

Raymond E. Crist

Dr. Crist, Professor of Geography at the University of Florida, is widely known for his work in Middle and South America.

ONE of the most impressive natural features in the West Indies is the east-west valley which extends across southern Hispaniola from Port-au-Prince, Haiti, to Barajona, R. D. The physical traits of this semiarid corridor remain practically constant throughout its entire length, but it is cut in two by a definite political and cultural boundary line. The cultural dichotomy of the valley will be examined against the background of the physical conditions, similar in both republics.

Physical Setting

The heart of the island of Hispaniola is a massif called the Cordillera Central, an immense mass of granitoid rocks. The great series of slates, conglomerates, and limestones belonging to the Cretaceous formation and which form the basis of the island has been pushed up, faulted, and folded by this central core of eruptive rocks. So much activity took place that few sedimentary strata are lying in a horizontal position. The coast formation, which lies unconformably on the Miocene and consequently must be either Pliocene or later, consists of limestones, the debris of old coral reefs, shore gravels (brought to the coast by rivers still existing) some of which are now beds of conglomerates resulting from the solidification of the last member, and, lastly, argillaceous and sandy beds having the same fluvial origin but owing their finer texture to the great distance they were transported before deposition. This shore formation extends inland and covers significant portions of the remarkable valley between Port-au-Prince and Barajona.

The Cul-de-Sac Plain is in reality not a cul-de-sac at all but rather the alluvial plain deposited in the Haitian sector of the tectonic depression which extends from Port-au-Prince Bay southeastward across the island of Hispaniola to the Bay of Neiba off the coast of the Dominican Republic, the part of the depression which lies within the limits of the Dominican Republic being called the Hoya or Basin de Enriquillo. High mountains rise abruptly above the plain on the north and on the south; the Bay of Port-au-Prince bounds it on the west and the large brackish lake, the Etang Saumatre, forms its eastern border. This lake, 17 meters above sea level, was effectively cut off from the sea by the delta—alluvial deposits of the Riviere Blanche which gradually sealed off the narrow arm of the sea; it probably emptied for thousands of years into Lake Enriquillo through a channel on the south side of the valley near the town of Jimani, remaining fresh as long as it overflowed as does the Sea of Galilee at the present time. When the lake no longer had an outlet, because the quantity of water flowing into it was first equalled then exceeded in amount by the moisture withdrawn by absorption and evaporation, its waters gradually became brackish.

The surface of the plain is made up of alluvial deposits laid down by the streams which flow from the mountains to the north and south. The only

through flowing surface streams that carry water to the margin of the Cul-de-Sac Plain emerge from the mountains which tower up on the south side of the valley in a bluish haze and receive most of the rainfall, and where most of the alluvium has been deposited. The greatest slope is nearest the southern border, where the streams are slightly entrenched, and gradually decreases to the north. The gentle northward slope of the plain continues to the very base of the purplish to bright gray foothills in the rain shadow on the north side of the plain where coarse rubble has been piled up in alluvial fans by flash floods from the mountains farther north. The northern half of the plain is very flat, built up by aggrading streams.

On the north side of the valley, between Lac Saumatre and Port-au-Prince Bay, there is an extensive fresh water lake or swamp, called Trou Cayman (Alligator Hole), which was formed in a low lying area between two alluvial fans. It was formerly the home of numerous alligators, as its name indicates, and also acted as a temporary haven for migratory water fowl. It was a favorite haunt of duck hunters who came out from Port-au-Prince. It has steadily lost water until now it is almost entirely dry except for a few mud holes in the lower part which are covered with water lilies and rushes.

Weather and Climate

The area enjoys a tropical climate, tempered somewhat by its insular position. The usual diurnal range is from about 75° F. at night to 85° or 90° F. during the hottest part of the day. By day a strong wind usually sweeps through the narrow valley from east to west. Even in the morning, when there is almost no wind movement in the mountains, the wind on the plain can be seen carrying smoke from the tiny peasants' huts in long streamers from east to west. The wind is funneled between the bordering mountains, is hot and drying, and makes some of the eastern part of the Cul-de-Sac Plain arid to semiarid. The plain receives less rainfall in the eastern sector than in the west around Port-au-Prince. Showers result when the temperature is high enough in the plain itself to create a low pressure area of sufficient intensity to draw in large quantities of moisture laden air from the Port-au-Prince Bay.

Fort-au-Prince had an average annual rainfall of 51.60 inches for the years 1924–1947, with December, January, February, and March being the dry months. For the same years 54.05 inches fell at the Bassin Generale, on the southern edge of the Cul-de-Sac Plain, while at Thomazeau on the north side of the Plain, in the lee of the mountains, 33.67 were recorded. There are great variations from month to month and from year to year: 62.64 inches of rainfall were recorded for Port-au-Prince in 1931, whereas in 1940 only 41.19 inches of rain fell.[1] And evaporation is of course very high.

Historical Background

The island of Hispaniola, discovered by Columbus on his first voyage, achieved a modicum of prosperity early in the 16th Century when gold was profitably mined in small quantities and sugar plantations prospered by using Negro slave labor. But with the conquest by the Spaniards of the wonder empires of the Incas and the Aztecs, Santo Domingo became little more than a port of call protected by a small garrison. Many of those living in Hispaniola moved to the Mainland in quest of El Dorado, and some estates were so completely abandoned that even the

[1] Data supplied by the Weather Bureau Office, San Juan, Puerto Rico.

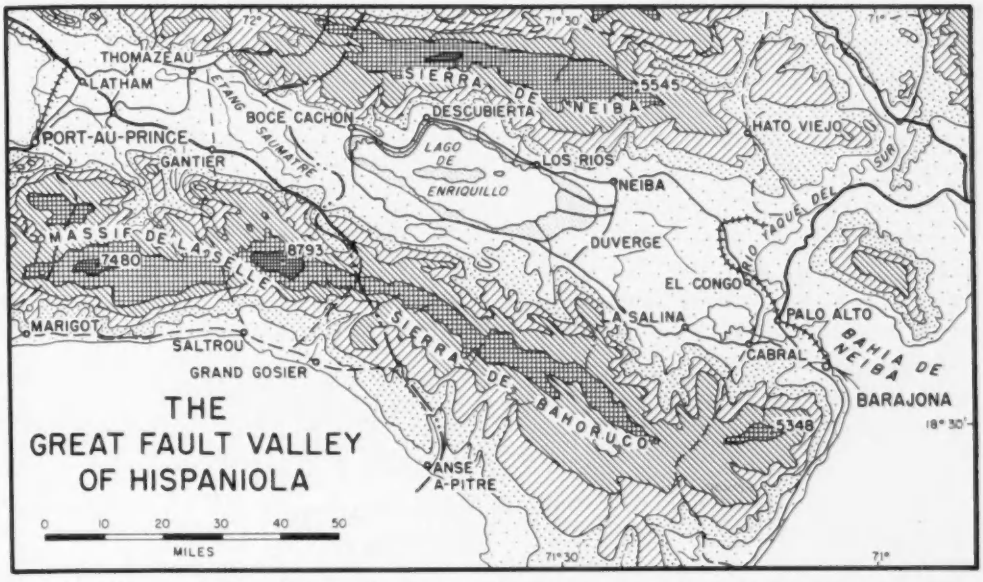

FIG. 1. The great fault valley stretches nearly 150 miles across Haiti and the Dominican Republic.

names of their owners were forgotten and cattle and hogs in great herds ran wild over the island. Mining declined in importance and agriculture languished to such an extent that the civil and military administration was paid for out of the wealth coming from Mexico. The western part of the island, practically deserted, began to be occupied by bands of buccaneers, principally French, who, between attacks on the rich Spanish Galleons, put in there for water and fresh meat. The buccaneers acted as a spearhead for Frenchmen desirous of practicing agriculture who were soon engaged in growing sugar, tobacco, coffee, and cacao on plantations where thousands of Negro slaves did the work. The wealthy planters bought great quantities of foodstuffs and cattle on the hoof from the Spanish part of the island, where the money thus put into circulation pumped new life into the rachitic agriculture, particularly of the northern sector, the Cibao.

The fertile Cul-de-Sac Plain early became one of the richest sectors of colonial Haiti, where the French established huge sugar plantations. Dams and aqueducts built 200 years ago by the French, to extend the irrigation system of the ancient Arawak Indians, are still in use.[2] The value of the tropical products exported from Haiti before the French Revolution was many times greater than the combined exports of the thirteen British colonies which later became the United States of America. Bryan Edwards, after a study of the colonial records, estimated that Haitian exports in 1791 were worth $40,000,000.[3] But the French Revolution, followed by the revolt of the slaves in 1791, spelled disaster for the plantation economy. White planters were killed or driven into exile; the ex-slaves parcelled the land among themselves and, in 1805, founded a Negro Republic.

LAND TENURE

With the collapse of the plantation regime, divisions of the land were made,

[2] Herbert W. Krieger: "Culture Sequences in Haiti," Smithsonian Institution, 1932, Publication 3134, p. 116.

[3] Woodring, Brown, Burbank: "Geology of the Republic of Haiti," Port-au-Prince, 1924, p. 77.

with the military leaders getting the lion's share, some of them as much as 6000 acres. Lesser military chieftains received up to 1000 acres apiece, but even the rank and file soldiers received about 15 acres. Later some of the large properties were abandoned by their owners and these tracts were appropriated by peasants.

Since a feeling of family solidarity exists among the Haitians which has militated against the actual division of land, there is much undivided and indivisible family land. Each branch of the family by common consent occupies a particular plot, and these holdings are respected by the other members. After two or three generations, division of the land becomes almost impossible, for if one has occupied a piece of land for 20 years he needs no legal title to that part of it where his house stands,

FIG. 2. Airview (18° 39′ Lat., 72° 17′ Long.) showing the marked contrasts in land use patterns on the sub-humid northern side of the Cul-de-Sac Plain, in the rain-shadow of the Montagne du Trou d'Eau: on the one hand the large blocks of land being reclaimed from the bush by the Haitian American Sugar Company and on the other hand, the tiny intensively cultivated parcels of the peasants, many of whom are now growing cane instead of food crops, because of the present high premium on cane. Scale approximately 1:31,450. (Courtesy of the Atlantic Refining Company and the Aero Service Corporation.)

or to the field which he is currently cultivating. Even if a person has cultivated overtly a piece of land for only a year he may, according to Haitian law, lay claim to it.

In spite of the numerous undivided and indivisible family holdings the land is still cultivated in small subsistence plots. Familial land tenure has not prevented individualism in the cultivation of the fields and in the usufruct thereof, and this has been one reason why modern machine techniques have not been introduced in level areas nor soil conservation practices tried out on the mountain slopes. And the trend toward a decrease in the size of plots continues. As a result of the governmental reorganizations under the American Occupation many members of the land-holding Haitian *elite* found themselves forced to divide and sell their land just at the time when peasants had more money than usual, due to stable political

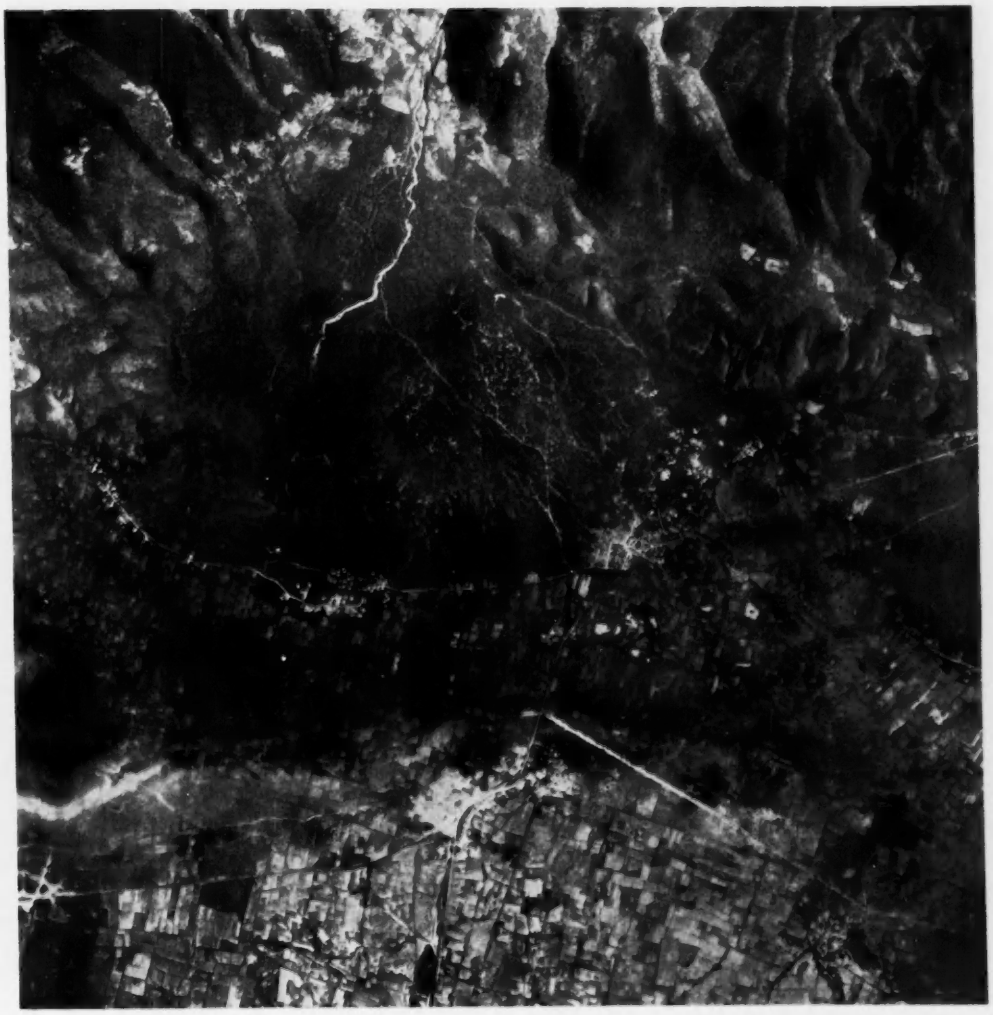

FIG. 3. Airview (18° 38′ Lat., 72° 6′ Long.) of Thomazeau on the coarse rubble of an alluvial fan on the north side of the Cul-de-Sac Plain. The dwellings of the peasants who cultivate the strips at the base of the fan, where both seepages occur and ground water is available, form ribbon settlements along a road on the steep, stony and infertile part of the fan. Scale approximately 1:47,000. (Courtesy of the Atlantic Refining Company and the Aero Service Corporation.)

conditions, and were able to purchase it. There is almost certain to be further parcelling of farming plots as the pressure of population on the limited land resources of the Cul-de-Sac Plain—indeed of the whole republic—increases.

The economy of the whole country is seriously affected by the extreme subdivision of land under cultivation. With each generation land holdings get smaller. Even if the heirs do not divide a property among themselves, they work plots individually. As the population increases the situation will get worse. A peasant who owns or works several widely separated plots of land makes the rounds, living on each one for a few months with the woman he keeps there. These polygamous unions, or "placages," mean a large number of heirs and hence further subdivision of land. In the past fifty years the cost of land has not only increased at least threefold but only minuscule plots of dry or infertile land are to be had at any price. Land is often mortgaged to get the money to meet large bills, such as lawsuits over boundary lines or the expenses of a funeral feast. Such debts are hard to pay, mortgages are foreclosed, and the result is that properties change hands frequently. Small wonder that farming techniques are primitive and organized on a hand-to-mouth basis.[4]

ECONOMIC AND SOCIAL CONDITIONS

The vast majority of the peasant farmers in the valley are "Toutistes"; that is, there is almost no division of labor and each man performs all the tasks on his little plots.[5] Further, while he clears a tiny patch for one crop he may be weeding a second on a near-by plot and planting a third crop in some other garden. Yams, rice, plantains, and bananas are important food crops grown in the Cul-de-Sac Plain. Every piece of land which will possibly produce food is sought out and used by the peasants. Indeed, the practice of raising plantains along the banks of the Ravine Boucan Brou, planting them down to the very edge of the water, proved disastrous at the time of the great flood in May, 1948. Millets and Indian corn are grown on the mountain sides, which have thin soils and are dry and steep. A portion of each year's harvest, no matter how meager, must be sold to provide small amounts of cash for the purchase of matches, kerosene, tafia (rum), tobacco, food not grown at home, and clothing. Chickens and eggs, too, are sold in the markets for cash. Most peasants do not live well; they eat one or at most two meals a day, and the diet is heavily overcharged with the starches of yams, rice, and plantains. The protective foods, meat, milk, and eggs, are beyond the purse of most peasants. Meat is eaten only on very rare festive occasions. It is amazing that on such a poorly balanced diet so much hard physical labor can be performed. The peasants are aware, however, of the importance of adequate food to a man doing hard manual labor; they know that resistance is lowered by malnutrition or actual lack of food, and give as a reason for not working hard during the off season, or dead season, that too much exertion on an empty stomach means that "malaria will take them to paradise." Widespread hunger, in many cases approaching starvation, is undoubtedly an important contributing factor to the general apathy of the inert, inarticulate masses.

In the Etang Saumatre, which is brackish, the salinity being about one-fifth that of sea water (it has no drain-

[4] A. Metraux: "Etude sur l'Agriculture Paysanne dans une Vallee Haitienne," *Acta Americana*, July–December, 1948, Vol. VI, No. 3–4, pp. 143–191.

[5] George E. Simpson: "Haitian Peasant Economy," *Journal of Negro History*, Vol. XXV, No. 4, October, 1940, p. 500.

FIG. 4. Typical peasant's house in the desertic eastern sector of the Cul-de-Sac Plain.

age at present, and is fed by small streams and springs), there lives a common species of small fresh water fish (*Cichlasoma haitiensis* Tee-Van)[6] locally known as "Odo." They are captured by using sheets of cloth as seines, and are taken in sufficient quantities to be a source of food for the local inhabitants —so great is the pressure of population on food resources.

An important item in the holding of land in most parts of the Cul-de-Sac is the right to water for irrigation. Until about a year ago water rights were bought at the rate of a dollar a year per hectare, but the new government decreed that this tax should be eliminated. As a result many small farmers have had their cropping regime disrupted, and a few influential individuals who knew the right people have got more water than was their usual quota. This situation has engendered general confusion and a feeling in many quarters of great injustice.

The opportunities for Haitians to emigrate to other parts of the West Indies are being curtailed, industries in which the surplus rural population might be absorbed are almost completely lacking, and the population is steadily increasing on a small and limited amount of land which it is impossible to make more productive under present conditions of ignorance and poverty. Inevitably it will be increasingly difficult in the future for a growing segment of the peasantry to achieve even a bare subsistence level of existence.

The Haitian American Sugar Company owns 9900 acres in the Cul-de-Sac Plain, a large part of which was not productive until it was irrigated and leached of its salt, and the company is planning to reclaim 2500 more acres by 1952 or 1953. The company has not

[6] John Tee-Van: "Ciclid Fishes in the West Indies" in *Zoologica*, Vol. X, Nos. 2, 3, and 4, 1935, p. 297.

deprived peasants of their farms, but it has extended virtual control over an estimated 30,000 acres owned by Haitians by the simple process of paying them more for cane than they can get by growing other crops. Almost 50 per cent of the total amount of cane (200,000 to 250,000 tons) ground by the company is bought from 9300 small proprietors, who, under the stimulus of high prices for cane, have largely neglected the growing of food crops. As the company increases the amount of land it owns outright it will probably buy less from Haitians who, having geared their way of life to a high yielding cash crop, will suffer a lowering living standard.

The small plot farmer has created for himself a vicious circle from which it is hard to escape: as population pressure has increased he has had to cultivate steeper and less fertile plots ever more intensively; but clean cultivation on such plots facilitates erosion which in turn further decreases productivity, making ever more difficult the achievement of national self-sufficiency in foodstuffs. Already basic foodstuffs are in short supply; mass hunger is so acute, even in some sectors of the fertile Cul-de-Sac Plain, that corn meal was being distributed gratis by the government in June, 1948. The wage hike by government decree, from 40 to 70 cents a day, has not been an unadulterated boon to the small plot agriculturalist, still the backbone of the national economy; thousands of them, attracted by the iridescent bubble of high wages, have ceased planting food crops on their small holdings in the higher areas in order to migrate to the villages lower down or even into Port-au-Prince itself, where seekers after work greatly outnumber the available jobs. The slums of the capital are already a serious social problem. These rural migrants are thinking in terms of what 70 cents bought at the time the decree was made. If the wage increase is not paralleled by growing productivity in agriculture and in handicrafts, it will prove to be a deception: soaring prices will more than offset increased wages, and the resultant inflation will mean hunger ever more widely disseminated, socially and geographically.

In comparing present conditions in Haiti with the rich plantation export economy of 1789, it must be kept in mind that (1) the newly freed slaves became landholders, but they lacked technical instruction and capital; (2) the new country was forced to pay France an indemnity of 60 million francs which otherwise could have been used to buy the technical skills and the tools wherewith to effect salutary changes in the economy; (3) the hostility of neighboring countries—still slave-holding—manifested itself in denying Haitian produce a market, thus condemning the country to self-sufficiency and commercial stagnation, with their attendant ills.

Observations made in the Cul-de-Sac Plain indicate that an accurate census is urgently needed. If a cadastral survey were made, land titles could be cleared and boundary lines legally and accurately fixed. A great deal of time and money now lost in litigation would be saved. The establishment of an agricultural bank where cheap short-term credit could be obtained by farmers for their seasonal needs would prevent many of them from having recourse to the usurer, whose practice it is to lend money at high rates on a first mortgage on the land; by foreclosure on such mortgages in the past the money lender has been able to add to his own holdings, which he worked on an absentee basis. Thus credit would give security to the small farmer and would help at the same time to curtail absenteeism. Agricultural production might be fur-

ther stepped up if the farmer were given practical grass roots education in seed selection, in crop rotation, in soil conservation practices, in the care of animals, and in the use of green and animal fertilizers.

THE LAKE ENRIQUILLO BASIN, DOMINICAN REPUBLIC

Lake Enriquillo, on the Dominican side of the frontier, is, geologically speaking, of recent formation. It is probable that the Rio Yaque at one time emptied into the Caribbean in the vicinity of the present site of Azua, following more or less the present course of the Quebrada Viajama and the Rio Tábara. Possibly as the result of faulting which separated the Sierra de Neiba from the Sierra de Martin García, the Yaque was able to make a right-angle turn, change its course, and empty into the Bay of Neiba, which at that time extended far inland to include the area now occupied by Lake Enriquillo. Then began the long struggle between the delta deposit of the Yaque River and the waters of the sea, comparable to that fought out by the Colorado River delta and the Gulf of Lower California. Little by little the Yaque extended its delta farther and farther into the narrow straight until at last only a few brackish lagoons and mangrove swamps acted as inlets which connected the sea with its almost landlocked arm. Then gradually these too were silted up and Lake Enriquillo came into being. The delta was so flat that slight variations in fall, over periods of geological time, caused the river to empty now into the lake, now into the sea. It is still so flat that in times of high flood the river empties into both bodies of water at the same time, by using a number of abandoned distributaries; this happened during the great flood of May, 1948.

The river still winds slowly across its meander-scarred delta plain and does not turn to the east until it has entirely crossed the valley from north to south. At Cabral, on the south side of the valley, the Yaque reaches the alluvial fan of coarse gravel and boulder deposits laid down by the wet weather streams from the calcareous Sierra de Bahoruco and changes its course to the east. Near Cabral the Yaque is connected with the Laguna del Rincon by a former channel, probably used at the time when it emptied into Lake Enriquillo. At present when the river is in flood it fills the Laguna, and when its waters go down the lake in turn flows into the river. But the level of Lake Enriquillo now averages 150 feet below the level of the sea, so that the fall to the west, in the direction of that landlocked body of water, is already considerably greater than toward the sea to the east. This channel to the lake that is used temporarily by flood waters of the Yaque River is being cut down vigorously toward a new base level. The management of the Barajona Sugar Company is haunted by the nightmare that the river may get out of control and cut a new deep channel into Lake Enriquillo, in much the same way that the Colorado River in flood began to drain into Salton Sea instead of into the Gulf of Lower California.

Once completely cut off from the sea by the dam formed by the delta deposits of the Yaque River, the level of Lake Enriquillo began to lower because evaporation exceeded the amount of inflow. The salt content of the lake water is now 2.35 times as great as that of sea water. The road on the north side of the lake, along the old Indian trail from Xaragua (now Port-au-Prince) eastward to Santo Domingo, in many places follows the beaches left behind by the receding waters of the lake. Here one "has the unique experience of walking

dry-shod on the bottom of the sea across shell-strewn sands and of wandering among forests of coral that appear so fresh that the water might have been withdrawn only yesterday."[7]

At the time the main graben was dawnfaulted certain corollary fractures or zones of weakness developed along the major fault lines, and small fault blocks were left standing above the level of the sea, such as the Cerros de Sal (Salt Hills) on the south side of the valley. In these shattered zones on both the northern and southern edges of the valley numerous hot and cold sulphur springs are found.

The area of subsidence is composed largely of incompetent strata which lie at different angles, as is shown by the cores taken out of Mella well No. 1, drilled to a depth of over 9000 feet by the Standard Oil Company in 1946. At a depth of more than 8000 feet a bed of salt 800 feet thick was drilled through, and at a little over 9200 feet a terrific pressure of CO_2 gas was encountered, so great that it shook the derrick violently and threatened to blow out the drill stem. The hope of striking oil or commercial gas was abandoned, the well was capped, and the company ceased drilling operations in the valley.

WEATHER AND CLIMATE

Most nights there is a land breeze which begins to be felt anywhere from 9 p.m. to midnight, once the mountains have radiated their heat and air drainage has set in. This breeze, a great boon to the comfort of the valley dwellers, can be very strong in the early morning, by which time the relative humidity has risen to 65–70 per cent.

By 9 o'clock in the morning at Barajona the land breeze dies down, people begin to perspire and to complain how hot it is. It will be observed that the smoke from the sugar mill is going straight up. But in a few minutes the sea breeze starts, and the relative humidity immediately sinks to 28 or 30 per cent, and this within just a few hundred yards from the edge of the sea. Once the breeze has begun, people no longer complain of the heat, because of the cooling effect on their skins of the evaporation of perspiration. The most marked temperature changes are sensible rather than actual, because the daily range is from about 75° F. in the early morning to 85° or so in the early afternoon. There is a difference of only a few degrees between high sun and low sun temperatures.

All day long, every day with few exceptions, the wind sweeps through the corridor formed by the Lake Enriquillo Basin and the Cul-de-Sac Plain. Under the strong tropical sun set in a gentian blue sky the wind heats up rapidly as it travels inland, the relative humidity continues to decrease, and conditions comparable to those on the Sahara prevail, with dust storms, small drifting sand dunes, and, near the lake, salt flats or *salados*, similar to the Chotts of North Africa.

On the sugar plantation properties an average of about 30 inches of rain falls each year east of the Yaque River and about 20 inches a year to the west, with maxima in May and October.[8] But both the amount and distribution are highly variable; e.g., only seven to nine inches of rain were recorded in 1947 on the plantations—at the station in Barajona the record reads 18.74 inches. Significantly, much even of the small

[7] Wythe Cooke, et al.: "A Geological Reconnaissance of the Dominican Republic," Washington, 1921, p. 39.

[8] According to the official report from the Barajona station, the average annual rainfall was 35.45 inches from 1925 to 1947 (not including the years 1926, 1931, and 1944, for which records are incomplete). Data provided by U. S. Weather Bureau, San Juan, Puerto Rico.

amount of rainfall is ineffective. If 1½ inches of rain fall between three and five o'clock in the afternoon they are as good as lost to the cane, which is merely washed off. The moisture is evaporated almost at once, and if the cane fields are being irrigated the sluices are not cut off. Even the dust in the road is moistened for only an inch or so in depth. If, however, there is an inch of moisture which falls in the course of the night as a slow steady rain, the irrigation sluices are cut off. Anything less than an inch of rainfall is considered of no value to the growing crop and irrigation sluices are kept open.

An indication of the effectiveness of the 20 to 30 inches of average rainfall is had from the following figures. A cane field in the Lake Enriquillo Valley requires 130 to 135 acre inches of water annually. The average amount of water applied on the fields by irrigation in the Barajona Central is 125 inches—with small local differences of a few inches, of course. In other words, the effectiveness of the 20 to 30 inches of annual precipitation is in reality only five to ten inches. Annual averages are virtually meaningless to practical field managers, who are interested in the effectiveness of the precipitation.

WATER TABLE

The water table is mapped every year, and it shows radical changes. By

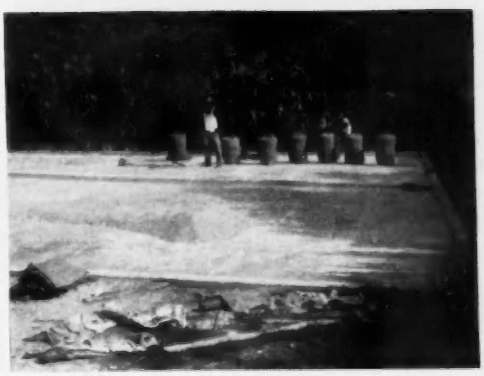

FIG. 5 (upper left). Masonry dam built by the French at Bassin Generale. This is still in use for the irrigation of a large cane acreage.

FIG. 6 (upper right). The desert village of Cristóbal, with large bayahonda trees providing the only shade. The main occupation here is the pasturing of goats, for there is no water for irrigation.

FIG. 7 (lower left). A house in the desert with the waving palms of the well-watered oasis of Duvergé beyond it to the north. Lake Enriquillo is in the background.

FIG. 8 (lower right). Drying and sacking rice in the patio of the home of a fairly well-to-do farmer at Neiba.

keeping track of the water table it is possible to determine whether irrigation water is being used by the growing cane, or whether it is being lost to the water table. Nine-month-old cane normally uses 50 per cent more water than three-month-old cane, but it will seem to use a lot more if close tab is not kept on the water table. The number of drainage ditches in a field also depends on the depth of the water table; a field with the water table two to three meters below the surface can get along with drainage ditches at 100-foot intervals, whereas, a field with water from only a meter to a half a meter below the surface must have drainage ditches at intervals of 20 feet.

SOILS

The young alluvial soils of the Enriquillo Basin, not having been formed in situ, have not yet developed a profile. The sandy loams of the natural levees are the best soils, and the second best are those that have been covered with a layer of silt. The clays in the low lying areas are the poorest, but even some of these have a relatively high silt content. The soils of the Barajona Sugar Central are high in soluble potash, ranging from 100 to 2500 pounds to the acre. The soils on which tests have been run are low in nitrogen, yet they produce yields of from 80 to 100 tons of cane to the acre, much higher than the low nitrogen content would seem to warrant. Perhaps there are non-symbiotic bacteria at work; that is, bacteria that can fix nitrogen in the soil without having to live on plant roots. Some weeds are legumes, but they are hardly responsible for nitrogen in the cane fields. The field manager reported that canes which are irrigated by overhead sprays seem to get more nitrogen than those that are not. Can it be that sprayed irrigation water simply is more effective in inducing plant growth than running water applied on the soil surface? There is room for a lot of experimentation on this problem. Phosphates are also in short supply. The quantity of iron seems to be nil, yet plants somehow get enough to live on.

Organic matter is deficient in all soils. In 1919 and 1920 the land was first cleared; the following year it was plowed, planted in cane, and irrigated. This process was disastrous because the irrigation water sank into the soil a short distance, dissolved the salts in lower horizons, came back to the surface by capillary attraction, and, upon evaporation, deposited the salts. To avoid this, a process of flushing had to be instituted: the soil was freely irrigated and the water drained off into drainage ditches. Most soils, particularly the clays, that have had the noxious salts removed have at the same time lost some of the elements necessary for best plant growth and are in poor physical condition. It is anticipated that cane in the experimental plots will show a good response to fertilizers containing both nitrogen and phosphorus. Up to the present the practice of the sugar company has been to clear new fields and flush them of their salts whenever the old fields began a marked decline in yields. But the end of extensive operations has been reached and intensification is the order of the day; in the future the policy of the company will be to work toward achieving a maximum sucrose content rather than a maximum tonnage of cane.

But more important than increasing or even maintaining present production of cane is the finding and holding of the market for sugar, for many factors beyond the control of the technician can effectively cut a producing area off from its accustomed outlet.

On the south side of the Lake Enriquillo Basin are found the Cerros de Sal

(Salt Hills), which contain thick beds of gypsum and rock salt, with strata almost vertical, as a result of down-folding and blockfaulting. Thinner gypsum and salt-bearing beds crop out as ridges in the midst of the valley near Lake Rincon, surrounded by alluvial deposits of the Yaque. Commercial deposits of salt in lenticular masses occur on the north side of the Cerros de Sal near the top. The rock salt is surface-mined by hand, huge slabs being pried loose with wedges and crowbars; it is lowered by cable dump bucket from the hill top to a crusher, where it is ground, sacked, and weighed before being shipped out by truck. The industry is now a government monopoly and figures on the amount mined were not made available. Thirty years ago the output averaged some 20 mule loads (about a ton and a half) a day. The capacity of present-day installations must be some five tons a day, but it was reported that the supply frequently exceeded the demand, so that operations were stopped until the stock on hand was used up. Much of the rock salt is so pure that it is used without refining, and locally it has the reputation of being superior to the product obtained by the evaporation of sea water at the coast. With the growing need for salt and other minerals as the country industrializes the amount of salt mined can be materially stepped up; however, the income from non-agricultural sources will probably continue to be a minor factor in the economy of the Lake Enriquillo Basin.

NATURAL VEGETATION

Throughout the entire valley xerophytic plants are common. Large areas of the plain are covered with thickets of bayahonda (*Prosopis juliflora*), a scrubby leguminous tree somewhat resembling mesquite. The trunks of many of these trees, knotty and gnarled, reach a diameter of a foot or more; the wood is very hard, takes a fine polish, and is used in cabinetmaking and construction as well as for railroad ties; these products are shipped to other parts of the republic on small sailing sloops. Candelón (*Acacia scleroxyla*), with a highly resinous wood, was formerly fairly well distributed throughout the brush-covered areas, but there are few specimens left at present. Baria (*Calophyllum brasiliense*) makes good construction logs. The almácigo (*Bursera Simaruba* L.) has a smooth reddish bark, is a fast grower, and is frequently used as living fence posts; the wood is used in the manufacture of packing boxes and cartons. Baitoa (*Phyllostylon brasiliensis* cap.), a tree with a whitish bark, is very common because it is completely worthless, even for use as firewood or for the making of charcoal. Both lignum vitae (*Guaiacum officinale* L.) and mahogany, still exploited to some extent, are becoming very scarce.

The bark of most trees is pretty well covered with large numbers of epiphytic bromeliads and orchids; rope-like climbing vines, the lianas, festoon the trees on the higher slopes. Columnar cereus and agaves are used as hedges around houses and *conucos* in many places. Many kinds of cacti, particularly opuntias, are wide-spread even on those mountain slopes not typically arid. Black mangrove trees (*Laguncularia racemosa* (L) Gaertn. f) of a foot or more in diameter, found along the abandoned river channels in the sector east of the present course of the river, are an index of the high salt content of the swamp water and soils. The sea grape (*Coccoloba uvifera*), common along most shores of the West Indies, is found along the beaches of the Bay of Neiba. Cana palms (*Sabal umbraculifera* Martius) grow around the swamps and in the oases and resemble royal palms in their

slender gracefulness and spidery crests; their leaves are extensively used for making thatch roofs and for weaving coarse ropes somewhat resistant to salt water, hence used by fishermen to tie the floats on their fish and lobster pots; the hard outer layer of the trunk is split up into boards and used very generally as weather boarding for the characteristic country house. Calabash trees (*Crescentia cujete*) are very common, and furnish the raw material for the making of water jars, bowls, dishes, spoons, and ladles. These items of household industry are made and used locally; they change hands in local markets where no records of the transactions are ever kept.

LAND TENURE

The Dominican Republic inherited the land system of colonial Spain. Property boundaries have been notoriously vague and titles to land hard to clear. A cadastral survey of the republic is being made at present. Those who desire to clear their land titles first have to have their property mapped by a registered surveyor, who submits his findings to the Tribunal de Tierras, a title clearing agency backed by the authority of the Federal government. The property owners on all sides of the piece of land surveyed are apprised of the proceedings by an announcement in the official newspaper, and a date is set for them on which to appear before the judge of the tribunal and to present the documents they hold. On the specified day the case is reviewed and any counter claims are considered by the judge, whose decision is final. The deed to the property surveyed is then registered as clear and the owner has title to the land—but not, of course, to the subsurface rights—in fee simple.

Up to the present a squatter who has lived on a piece of unused land for a year and a day and who has harvested a crop on it has thereby acquired certain rights which are valid in the courts. He can be ejected only upon agreement satisfactory to him and to the owner of the land. If the case is taken to court the judge decides the amount of money due the squatter for having to abandon his house and clearing. Court costs are borne by the plaintiff. The reform in clearing land titles will greatly modify if not liquidate squatters' rights.

In a desert or semiarid area land ownership alone has little meaning if

FIG. 9 (left). A steep and stony mountainside, eroded and infertile, being prepared for planting. Returns are so uncertain and marginal that many such peasants in desperation migrate to Port-au-Prince.

FIG. 10 (right). Hut in the outskirts of Port-au-Prince lived in by a migrant from the country.

the owner does not secure rights to adequate water to irrigate it. Unscrupulous landlords sometimes rent plots to an individual who in good faith clears the land and plants crops only to find that he is then denied access to water. The landlord thus gets his land cleared gratis, and can incorporate it into his other irrigable holdings.

LAND USE PRACTICES OF THE SMALL FARMER

The gently sloping silt-covered areas left by the receding waters of Lake Enriquillo are the agricultural lands *par excellence* which support the populations of the villages, located usually on the alluvial fans where either surface or spring water is available. Some of the streams from the mountain sides disappear into the coarse gravels at the apices of the alluvial fans they have deposited, filter slowly through subsurface strata, and reappear at a lower level as flowing springs when they reach an impermeable layer of fine silt or clay. The villages and dispersed houses are themselves located on dry, rocky areas, thus leaving the fertile, irrigable soils free for crops. The amount of land under cultivation depends on the amount of water available for irrigation: Neiba is the largest town because it has more water for agriculture than any of the other oases. Spring water, and surface water brought in ditches, are used to irrigate fields on the extensive flats covered by lacustrine silts and clays.

Since the amount of irrigable land is strictly limited by the amount of water available, each unit is made to produce to capacity by a system of interculture. Three or four crops will be growing simultaneously on the same piece of land. One field was seen with thriving stands of plantains, corn, casabe, squash and pigeon peas (*Cajanus indicus*). On the bushes which formed a fence around this plot were growing many vines of chayote (*Sechium edule* Jacq.) heavily laden with the succulent fruits which are so popular as a vegetable dish. Of course, these crops are harvested at different periods, so that farm labor is spread throughout the year. Yams too are grown in many plots and the per unit yield is high. Rice is sown in inundated depressions along the lower course of the Yaque River and a crop is taken off before the drought is too great to harm it. A very tasty tropical grape is being grown in considerable quantity in the oases villages now, for which there is a good market in Barajona, and even in the capital, since road improvement has facilitated truck service. Yet a single step from an irrigated plot takes one from rich farmland to the domain of the ubiquitous goat or woolless sheep. Goats frequently resemble pin cushions, with their skins thickly studded with cactus spines.

LAND RECLAMATION ON THE BARAJONA SUGAR ESTATE

The most significant change in the land use pattern of the Lago Enriquillo Basin has been wrought by the Barajona Sugar Central; 65,000 to 70,000 short tons of 96-degree sugar are produced each year where formerly a few goats grazed. Some 20,000 acres of dry saline soils have been made to produce heavy yields of cane by the application of water, first to flush out the salt and later to irrigate the growing crop. In other words, this company has practiced technological pioneering, which requires the expenditure of large amounts of capital in the use of modern technological methods. Indeed, the present day pioneer needs capital and technological know-how, whether he is trying to grow vegetables in Alaska, corn in Siberia, or sugar cane in the dry

tropics. Increasingly, the sums required for such pioneering enterprises are so great as to be prohibitive for individuals, so that it seems likely that in future capital will be more often supplied by corporations or governments.

POPULATION INCREASE

The estimated population in the Lake Enriquillo Basin at the present time is markedly higher than the 1935 census figures alone would seem to warrant. But there are sound reasons why the population is increasing apace: a general feeling of security exists, that was unknown in the troublous years of chronic revolutions; young men in ever greater numbers stay home and found families instead of wandering around in revolutionary bands as formerly. Further, public health measures are being more extensively applied; great efforts are made to secure pure drinking water, privies are becoming more common, and pigs are no longer the only garbage disposal units. Education in the principles of rudimentary hygiene, though much is still to be done, has certainly been a factor in decreasing the high rate of infant mortality. A growing number of people have less faith than formerly in *curanderos*, *brujos* and *practicantes*, and hence are willing to call a trained physician, if one is available. Enormous numbers of children under five years of age are seen in all oasis villages and in most houses, even in solitary huts in the desert itself, where diseases are less prevalent than in the wet tropics. But the physical resources of many areas are so narrowly limited as to make population growth possible only at the expense of the standard of living. One cannot but wonder if the rate of population increase will not be greater than the rate of increase of agricultural and manufacturing production. Will population grow faster than the wherewithal to feed it and at the same time raise the general standard of living or will control factors enter in that have not been operative, e.g., in Barbados and Puerto Rico?

FIG. 11 (left). Loading bananas by hand in Barajona; most of them are grown on small holdings, and the total acreage has never been computed.

FIG. 12 (right). Cars of sugar cane waiting to be unloaded in the Barajona mill.

The Dominican Republic has only a land frontier between it and a densely populated country, Haiti, where the pressure of the population on resources is very great. The pressure of population in the Dominican Republic is much less; the frontier zone is sparsely settled, with the result that Haitians have, during the past century, tended to expand eastward. There has been a movement to counter this pressure in the Dominican Republic by means of government-sponsored colonization and road-building projects, similar to the projects of the Romans along the Rhine

and the Danube that were motivated by the idea of keeping out the barbarians. An economic factor also enters in: Haitian laborers work more hours for less money than do Dominicans. Hence, a large layer of the working class is opposed to this competition. Furthermore, there is a racial angle: little white blood exists in Haiti, and a comparatively high percentage in the Dominican Republic, whose leaders do not want to see the population negroidized.

How are we to account for the present differences in population pressure between the Cul-de-Sac Plain and the Lake Enriquillo Basin? In the beginning, both sectors alike were divided up in large estates. In Haiti plantations of sugar cane under irrigation were established under the Colony, but with the Revolution the large landholders were expelled and the ex-slaves became the owners of small plots of land. They acquired a feeling of relative security, and, in spite of poor farming techniques and lack of capital, the institutional set up favored a rapidly increasing population. On the Dominican side of the valley the land use patterns were to a great extent fixed in the mold of the great landed estate during the Colonial Period; only recently have they been modified through the introduction of modern techniques so as greatly to increase the human carrying power of the area.

CONCLUSIONS

It has been seen that the outlines of the pattern of human occupance are only faintly suggested by the natural environment: the details are filled in by man; differences in cultural backgrounds, in historical development, and in land tenure practices account in large part for the variety of patterns which have evolved on physically similar landscapes. In other words, the evolution of a land use pattern is like the making of a rug: the loom and the materials are the natural environment and man is the weaver upon whose acquired skill depend the pattern and the texture of the finished product.

Problems of population pressure and migration, of land use practices and land tenure systems, can be more clearly brought into focus if the geographic position and the historical background of Haiti and the Dominican Republic be kept in mind. This island with the other Caribbean islands forms a geographic unit in which many foreign nations have political or economic enclaves.[9] Islands close to each other in space, or even parts of the same island, may be incorporated into the economies of distant countries, their well-being dependent upon the whims of overseas consumers and pressure groups of many different lands. Even such islands as remain politically independent are buffeted about on the rough seas of the international market, tossed between the Scylla of self-sufficiency, with a low standard of living and the Charybdis of monoculture, with a resultant colonial economic status.

ACKNOWLEDGMENTS

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[9] Carlos E. Chardon: "The Caribbean Island Economy," *The Scientific Monthly*, September, 1949, Vol. LXIX, No. 3, pp. 169–172.

PROBLEMS OF GRAZING ADMINISTRATION IN THE BASINS OF SOUTHERN WYOMING

Wesley Calef

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THE function of the Division of Grazing of the Bureau of Land Management in the Department of Interior is to direct, in cooperation with local ranchers, the agricultural utilization of the range lands of the West. The local administrative officers operate under the guidance of a few general rules set down in the Taylor Grazing Act and under an elaborate set of rules—The Federal Range Code—evolved by the Bureau of Land Management. Since each district differs from the others, the general rules must be modified in their application to particular districts. It is the purpose of this paper to examine the problems of range administration as they relate to the local variations of natural and cultural features in southern Wyoming.

Southern Wyoming is divided physiographically into three major basins, here designated the Laramie Basin, the Red Desert, and the Bridger Basin. Although the boundaries between the basins are not everywhere sharply marked, nevertheless the areas are sufficiently distinct so that local citizens speak of them as separate entities and recognize clearly their individual characteristics.

Livestock raising is the only type of agriculture in the entire region. Almost all grazing land is uncultivated, unirrigated range land. Southern Wyoming is overwhelmingly an area of range livestock production.

Though the different basins have many characteristics in common, any superficial appearance of great similarity is entirely misleading. With regard to at least seven major factors affecting grazing administration major differences exist between the various basins. Wyoming Grazing District 3, with headquarters at Rawlins, occupies the eastern section, and Grazing District 4 centering on Rock Springs, covers the southwestern corner of the State. Their location may be seen on the map (Fig. 1).

THE LARAMIE BASIN

The area of simplest administrative problems is the Laramie Basin. It is an area of cool summers and long, cold, snowy winters. The vegetation cover is largely grass (Fig. 2). The basin is surrounded on three sides by mountains. Stock water is available in all parts of the basin and enough irrigation water is available to irrigate some of the arable land. The lands of the basin itself can be grazed with profit throughout the summer, spring, and fall. In short, the Laramie Basin is a high-grade grazing area. Consequently, most of the land in the Laramie Basin passed into private ownership early in the history of settlement. In the southern half of the basin federally owned lands

make up only a small portion of the total acreage. In the northern section the proportion of federal land is higher but nowhere does it exceed half the total land area.

The federal lands are everywhere isolated tracts entirely surrounded by private land, and most of the private land is fenced; hence the area is comparatively simple to administer. All federal land in the area is administered under what is called technically by the Bureau of Land Management "Section 15 leases." These leases are quite similar to ordinary leases between private individuals. They run for a period of 10 years. The livestock operator pays a flat fee for the privilege of grazing a stated number of cattle on the leased land for a stipulated period of the year. The leases for a particular tract are made to one individual for exclusive use.

In the Laramie Basin these leases are extremely easy to administer. Since the leased land is almost invariably adjacent to the lessee's private land (and commonly partially surrounded by it), trespass is kept to a minimum. Because the lessee has sole use of the land, it is to his interest immediately to discover and report any cases of trespass. Moreover, unwitting trespass is almost impossible.

Enforcement of the grazing season limits and livestock numbers is easy, because all the cattle on an individual lease belong to a single owner. Consequently, merely counting the number of livestock on a comparatively small area at any time will establish whether the area is being grazed in conformance with the terms of the lease.

In summary, we may reiterate that administration of grazing on the federal land in the Laramie Basin is one involving practically no problems once the carrying capacity of any piece of federal range has been approximately determined.

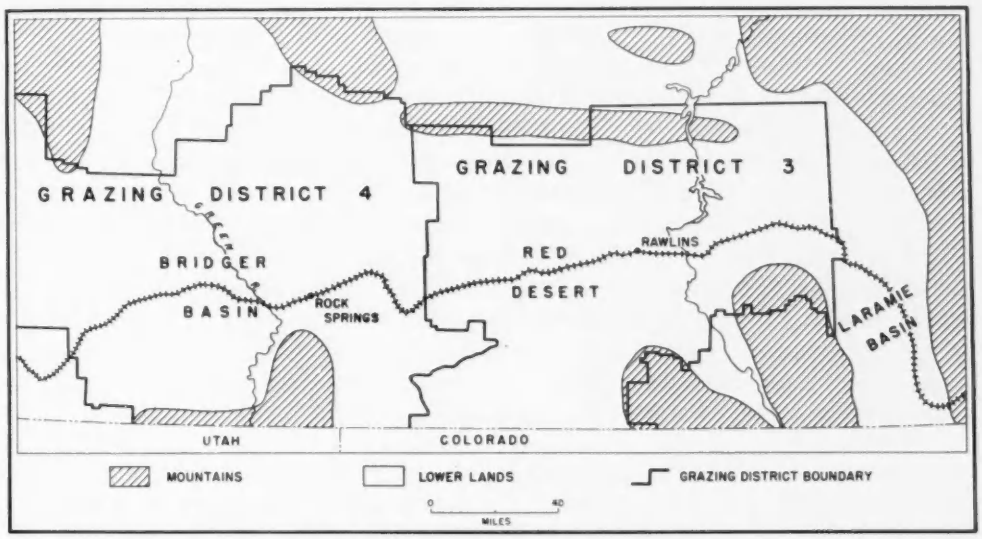

FIG. 1. Grazing Districts 3 and 4 in southern Wyoming. Shaded areas are mountains, largely serving as summer range. Public Domain lands outside District 3 in the Laramie Basin are administered from Rawlins.

THE RED DESERT

If we turn our attention to the remainder of Wyoming Grazing District 3, the Red Desert area, we find com-

FIG. 2 (left). Grass ranges of the Laramie Basin. Note the stand of grass in the right foreground and extending to the horizon. Shrubs (upper left) occur only on excessively drained or rocky land.

FIG. 3 (right). Vast expanses of low-capacity, brush covered winter range in the Red Desert section of Grazing District 3.

pletely complex grazing pattern, and extraordinarily difficult problems of grazing administration. Both the natural and cultural phenomena in the area seem almost to have conspired to make the grazing pattern one of extraordinary complexity.

It is an area of desert shrub supported by a low rainfall (Fig. 3). Its carrying capacity is very low; in many places as much as 10 or 15 acres of range land are necessary to furnish one animal unit month of grazing. Sources of stock water are few and widely scattered. As a result most of the area has been utilized since the beginnings of settlement as winter range for sheep, because sheep can graze an area much more satisfactorily than cattle.

Because of the extremely low carrying capacity of most of this range country, it seems highly probable that almost all of the lands of the Red Desert area would have remained in federal hands had it not been for two complicating historical factors.

The Union Pacific Railroad was granted alternate sections of land in a strip extending 20 miles out on each side of the roadbed. Since receiving the land grants from the federal government the railroad subsequently disposed of most of these lands to other private owners. The Union Pacific now owns only a very small portion of its original holdings. But, unfortunately, only a few large blocks of railroad land fell into the hands of any one owner. These large holdings largely adjudicate themselves. But the ownership of the rest of these former railroad lands is now widely scattered. Moreover, since most of the land was of very low quality very few attempts were made to homestead any of the alternate, federally owned sections. Consequently, if we color in either the private or federal holdings on a map, our end result over most of the map is a regular checkerboard pattern and these lands are referred to as the "checkerboard lands" (Fig. 4).

To the southeast of the Red Desert area is a major mountain range, the Sierra Madre Mountains. Issuing from these mountains are streams of water which drain off to the north and traverse the eastern half of the area. Along these streams irrigation was feasible at many points, and at least a reliable source of stock water is available. Consequently, there is a ribbon of privately owned land extending along each of these streams (Fig. 4). The agriculture of the area was predominantly range livestock grazing so that there was little incentive to attempt to obtain long

sections of these stream courses because irrigated land was not the basis for the grazing industry. Consequently, most of these riparian lands are broken up into comparatively small holdings.

Moreover, along the flanks of the mountains where numerous small streams issue from the mountains, where the rainfall is higher and the forage better, and for some other minor reasons there is a concentration of private land. In some places the land is almost entirely privately owned, in other areas only a fifth or a fourth of the land is in private hands. But here also most of the individual properties are small and complexly interspersed with blocs of federally owned lands of various sizes and shapes.

The assignment of individual range allotments is practically impossible over large sections of the public domain under such a pattern of land tenure. Consequently, contiguous areas of public domain of even modest size commonly are used collectively by several permittees.

But it must be kept in mind that the basis of range permits under the Taylor Grazing Act was prior use of the range. Through a long series of informal use-practices the pattern was further complicated. A large sheep operator may have used a portion of the Red Desert for a band of sheep, but he may also have grazed a small band of horses on the federal range adjacent to his ranch throughout the year. Or he may have grazed a small herd of cattle on federal range adjacent to a piece of spring range which he owned privately near the base of the mountains. This materially increased the complications of the pattern of allotments and permits.

Such an allotment pattern is extraordinarily difficult to administer. Trespass is difficult to establish. Moreover, since there are no fences it is difficult to prove that trespass was intentional. Many minor deviations from the terms of the permit by the permittees are possible. Since numerous permittees are using a given allotment there is little (or, at least, much less) incentive to maintain the range in good condition because of the possibility that some other permittee will reap the benefits. Responsibility for overgrazing the range is difficult to fix when several permittees are using it simultaneously.

There are other difficulties. The desert area is large and supports large numbers of sheep during the winter. Most of these sheep are grazed far to the south in the Rocky Mountains during the summer. This necessitates a long annual round trip of very large numbers of livestock. In order to keep this migration from completely disrupting the range allotments, sheep movement must be confined to a few major trails. These trailways now have become the sections of most serious range deterioration in the entire grazing district. But another difficulty is also encountered. A band of sheep moving along the trail may drift to one side or another and discover an area of excellent forage on an unfenced adjacent allotment. There is a strong temptation to stop and let

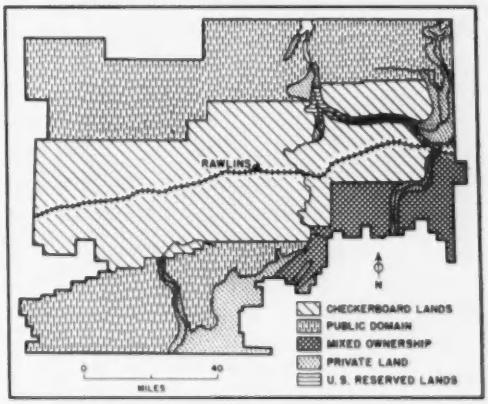

FIG. 4. Land status, Grazing District No. 3, Wyoming. (For regional setting of district see Figure 1.)

the herd feed for a few hours or a day; or, if there is good reason to think they are undetected, for a period of two or three days. A herd of 2400 sheep feeding for two days will use 160 animal unit months of forage from an allotment. If trespass is detected, the herder can blandly say, "I didn't know we were off the trail."

Still another factor tends to complicate the situation. During almost every winter some part of the Red Desert area

FIG. 5. Winter range for sheep in the "Checkerboard" lands of Grazing District 4. Its character and capacity are essentially similar to those of the winter range lands of Grazing District 3.

is covered with snow to a depth that makes it impossible for sheep to graze. As we have emphasized, this is an area of range sheep production. The ranchers have few facilities for feeding or little feed for these sheep. Consequently, they must be moved to some other section of the range. An adjustment of an already complex grazing situation is necessary.

If, as is the case with many of the large sheep companies, the operator has permits in two allotments the shift may not be so difficult. All the sheep can be placed on the one allotment that is open. This puts doubly heavy pressure on the one allotment, but the following winter all the sheep can be grazed on the other allotment. But such simple adjustments are not possible if a man had a permit in only one allotment. Then the rights of other permittees, the condition of the range, and other considerations need be taken into account. The difficulties involved are sufficiently obvious to make an extended description unnecessary.

Prior to the introduction of the Taylor Grazing Act, this was an area of heavy grazing pressure. Since grazing of the federal range was open to everyone the ranchers of this area needed to be aggressively alert and watchful to protect their extra-legal "rights" on the range from encroachment by others. Not uncommonly rather strong extra-legal measures were used to protect or enlarge individual grazing areas. There has

been a strong carry-over of this aggressive attitude toward the Bureau of Land Management. The Bureau is still regarded by many livestock operators as an agency to be exploited, watched, traded with, or thwarted, rather than an organization having mutual interests with the ranchers and enlisting their cooperation. It is common practice for many permittees to discuss their affairs with the District Land Manager in Rawlins only when accompanied by their lawyer, who, incidentally, often does all the talking for the permittee. Obviously in such an atmosphere radical adjustments in range management are not easily made.

THE BRIDGER BASIN

We may see more clearly the force of this last cultural trait by comparing conditions in the Red Desert area with those in Grazing District 4 which embraces southwestern Wyoming west of the Red Desert.

In many ways the physical land conditions are very similar. Desert shrub vegetation and scanty rainfall keep the carrying capacity low (Fig. 5). The yearly migration between the winter and summer range is very long. The pattern of land tenure is essentially similar to that of the Rawlins area and equally complex. The Checkerboard lands pass through the heart of Grazing District 4 in the same manner as in District 3. But in the history of the grazing industry of the two areas there has been one major difference. Although the Union Pacific Railroad lands were largely alienated by the railroad, just as in the Rawlins District, on the other hand, large contiguous portions of these railroad lands came under the control of two large grazing organizations. These two organizations were made up of numerous sheep operators from the area. In these grazing associations the livestock men learned to cooperate in managing the range for maximum forage production, in scheduling periods of range use, in establishing supplementary sources of water, and in meeting all the other problems involved in cooperative use of the range.

Consequently, when the Taylor Grazing Act was instituted in District 4 it did not constitute such a sharp break with past practices. Problems involving hundreds of square miles of grazing land could be taken up by the Bureau of Land Management with an organization already familiar with the handling of such problems.

Therefore, despite the fact that physical land conditions and land tenure patterns would seem to indicate a grazing problem very nearly as complex and difficult as in the Red Desert area, this difference in the historical development of the grazing industry of the two regions has resulted in a more satisfactory solution to the range management problem in District 4 both for the individual rancher and for the Bureau of Land Management.

INDUSTRIAL EXPANSION IN THE UNITED STATES, 1939–1947

John W. Alexander

Dr. Alexander, assistant professor of geography at the University of Wisconsin, has published several previous articles in this magazine. His "Manufacturing in the Rock River Valley—Location Factors" appeared in the September, 1950, issue of the ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS.

MANUFACTURING experienced a marked growth in the United States between 1939 and 1947, the years of the two latest releases of the United States *Census of Manufactures*. In 1939 there were 7,808,000 production workers in American factories. In 1947 they numbered 11,916,000. This is a gain of over 4,108,000 people, 52 per cent of the 1939 number! During this same eight-year span the population of the United States grew by only 9 per cent. Clearly the period of World War II saw the United States become considerably more industrialized.

Where did this phenomenal growth occur? Did all industrial areas expand at a 52 per cent rate, or did some exceed others? If so, where are the regions which grew fastest? Where are those which lagged?

Further, in those regions which grew vigorously did all types of industry boom at a comparable rate or did some outstrip others? Conversely, in those areas of little growth did all industries lag or did a few gain while others lagged?

Answers to these questions will be presented by means of maps and graphs which measure changes in industrial distribution in terms of employment. There are numerous criteria for measuring manufacturing: employment, value of product, value added in the manufacturing process, capital invested, power consumed, plant capacity, and others. Regional expansion of industry could be measured in terms of any of these, but in this study the criterion of employment has been selected for three reasons: (a) regional changes will be reflected by it, (b) it is a familiar criterion and easily understood, (c) it is directly related to other geographic elements in a community; that is, a change in number of industrial workers in a community is reflected in a changed demand for housing, trade, services, transportation, schools, etc. Use of the criterion of employment will reveal in simple fashion the basic regional changes in distribution of manufacturing. However, it is recognized that the use of additional criteria could show many more aspects of those changes.

Attention will be directed first toward the United States as a whole and secondly toward major regions.

I. CHANGES IN THE UNITED STATES AS A WHOLE

Changes in industrial employment in the entire United States will be measured first in absolute terms, then in relative terms, and then will be broken down according to types of industries.

A. Absolute Growth

United States industry added 4,108,000 production workers to its payrolls between 1939 and 1947. The distribution of these four million people is shown in Figure 1.

Most of the growth occurred in the northeastern portion of the country. This is in contrast to a widespread opinion that most of the nation's new industry is in the South and Far West. Table I lists the 31 industrial areas or counties which grew by at least 20,000 production workers. A growth of 20,000 production workers has been selected arbitrarily to segregate industrial areas which experienced the largest growth. Twenty-seven of the 31 areas in Table I are in the northeast quadrant of the nation. Only one (Houston) is in the South and two are on the West Coast. Moreover, 10 of the first 11 are in the northeastern quadrant of the United States. It may surprise some readers that the Northeast had *twenty-four* industrial nodes which expanded their industrial employment more than did the South's leader, Houston.

The industrial areas which grew most were New York, Chicago, Los Angeles, Detroit, and Philadelphia. These were the only metropolitan areas to add 100,000 or more production workers to factory payrolls. Furthermore, the combined growth of these five leaders was 1,106,000 production workers. This was 27 per cent of the nation's total growth of 4,108,000 wage earners.

At the end of the eight-year period of change discussed herein, the pattern of manufacturing in the United States was very similar to the pattern of absolute change. Figure 2 showing the distribution of manufacturing in 1947 appears to be very similar to Figure 1 showing the distribution of absolute growth. The conclusion is that from 1939–1947 the regions which had the most industry were the ones receiving the most additional industry. These facts refute the fallacious impressions given by some popular articles that industry is making an exit from the industrialized Northeast in order to take root in the South and West. It was the main manufacturing belt which experienced the largest growth.

As a result of changes during this eight-year period the rank of America's

TABLE I

ABSOLUTE INDUSTRIAL GROWTH IN METROPOLITAN AREAS AND COUNTIES* 1939–1947

	Increase in thousands of production workers
1. New York	407
2. Chicago	278
3. Los Angeles	154
4. Detroit	151
5. Philadelphia	116
(Subtotal of first five areas—1,106)	
6. Pittsburgh	93
7. Cleveland	89
8. St. Louis	74
9. Milwaukee	61
10. Buffalo	58
11. Boston	57
12. San Francisco	54
13. Minneapolis–St. Paul	45
14. Dayton	39
15. Cincinnati	36
16. Akron	35
17. Indianapolis	34
18. Baltimore	32
19. Hartford County, Conn.	32
20. Youngstown	31
21. Rochester	29
22. Fairfield County, Conn.	29
23. Louisville	26
24. Toledo	26
25. Hampden County, Mass.	24
26. New Haven County, Conn.	24
27. Houston	23
28. Kansas City	23
29. Providence County, R. I.	22
30. Worcester County, Mass.	21
31. Seattle	21

Source: United States Census of Manufactures, 1947.

*"Industrial Areas" as defined by the Census coincide with "Metropolitan Areas" and often consist of an entire county (or even two or more entire counties). For example, "Houston Industrial Area" and "Harris County" are coextensive. However, in some places such as New England, industrial areas constitute only segments of counties. In such instances, the entire county has been entered in Table I in order to harmonize it with other industrial areas which are defined on a county basis.

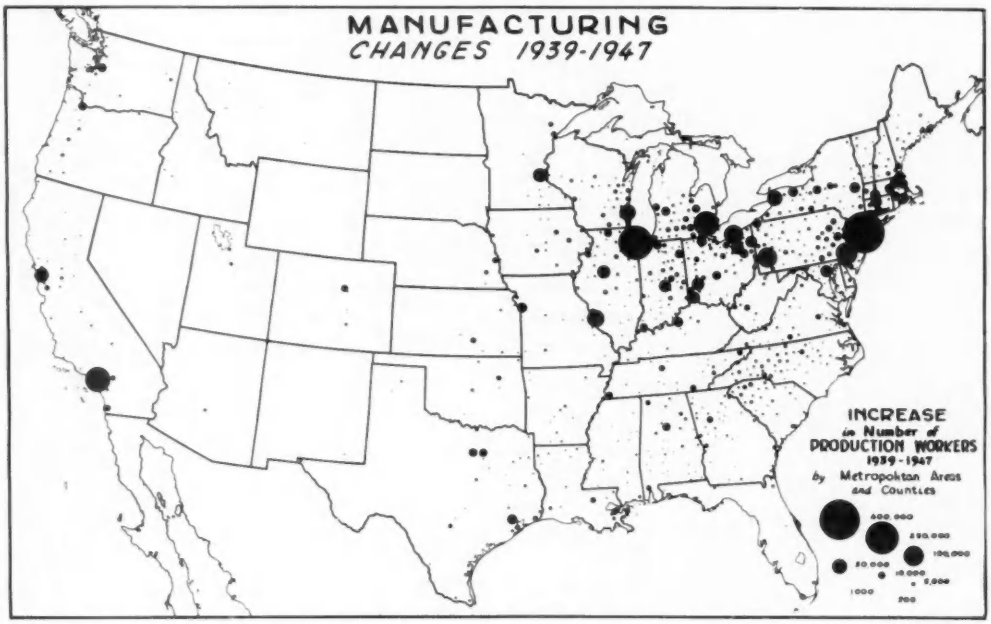
MANUFACTURING
CHANGES 1939-1947
INCREASE
in Number of
PRODUCTION WORKERS
1939-1947
by Metropolitan Areas
and Counties

FIG. 1.

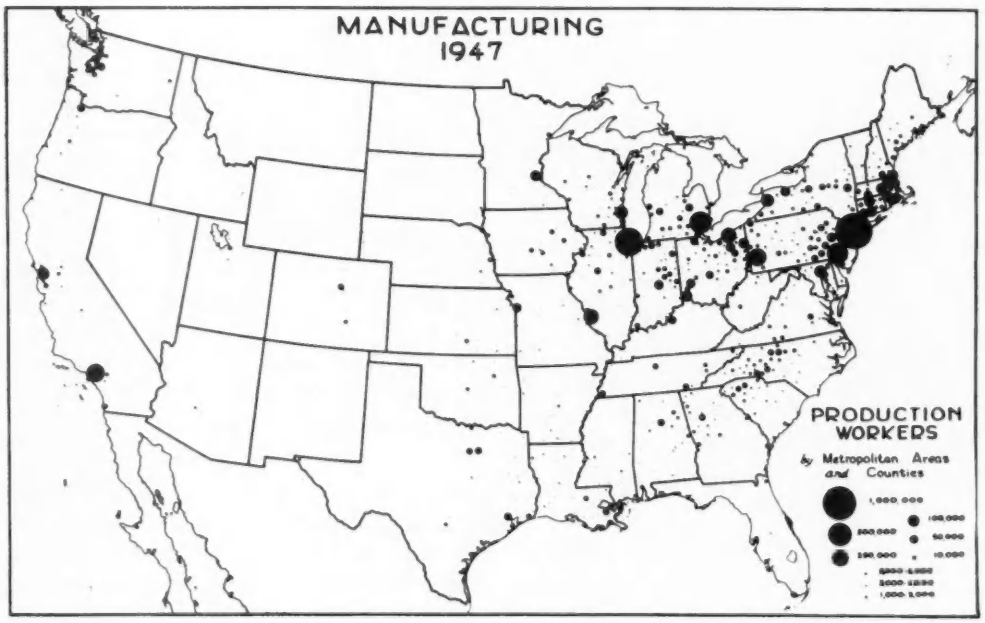
MANUFACTURING
1947
PRODUCTION
WORKERS
by Metropolitan Areas
and Counties

FIG. 2.

TABLE II

RANK OF LEADING INDUSTRIAL AREAS* 1947 AND 1939

	1947		1939		Growth 1939–1947 in production workers (000)
	Rank	Production workers (000)	Rank	Production workers (000)	
New York	1	1,274	1	867	407
Chicago	2	756	2	478	278
Detroit	3	466	4	315	151
Philadelphia	4	437	3	321	116
Pittsburgh	5	284	5	191	93
Los Angeles	6	281	8	127	154
Cleveland	7	218	7	129	89
Boston	8	215	6	158	57
St. Louis	9	200	9	126	74
Buffalo	10	149	12	91	58
Milwaukee	11	141	13	80	61
Baltimore	12	138	10	106	32
Providence	13	131	11	95	36
San Francisco–Oakland	14	131	14	77	54
Cincinnati	15	108	15	72	36

Source: United States Census of Manufactures, 1939 and 1947.

*"Industrial Areas" include the core city and contiguous suburbs and remainder of county or counties as defined in the Census.

largest *industrial areas* was somewhat juggled. Philadelphia lost its third place position to Detroit. Los Angeles and Boston reversed their positions behind Pittsburgh; indeed Los Angeles almost overtook Pittsburgh! Buffalo and Milwaukee surpassed Baltimore and Providence. Table II lists all industrial areas with 100,000 or more production workers as of 1947, the last year in which a Census of Manufactures was taken.

B. Relative Growth

The regions which grew the *most* between 1939 and 1947 did not necessarily grow the *fastest*. There is a difference between *amount* of growth and *rate* of growth. Amount is measured in terms of increased numbers, while rate is measured in terms of percentages.

For the United States as a whole the rate of growth was 52 per cent. Figure 3 shows the distribution of industrial counties (those counties which had at least 1000 production workers in manufacturing in 1947) and industrial areas in terms of percentage growth. Those which exceeded the national rate of 52 per cent are shown in black, those which grew at a slower rate are lined, and those which did not grow, but lost, are dotted.

The nation's widest expanse of rapidly growing industry extends from northern Ohio through southern Michigan, northern Indiana, northeastern Illinois, and southeastern Wisconsin. There are numerous other "black" areas indicating rapid growth, but none is as extensive as this midwestern industrial zone; most of America's rapidly growing industry is located here.

The main industrial belt of the country (between the Mississippi River and the Atlantic Ocean, north of the Ohio and Potomac Rivers) can be said to resemble a teeter-totter pivoted in western Pennsylvania and New York. To the west the prevailing rates were ahead of the nation's; to the east the prevailing rates were slower. Indeed, most of New England, New York, Pennsylvania, New Jersey, and Maryland lagged behind.

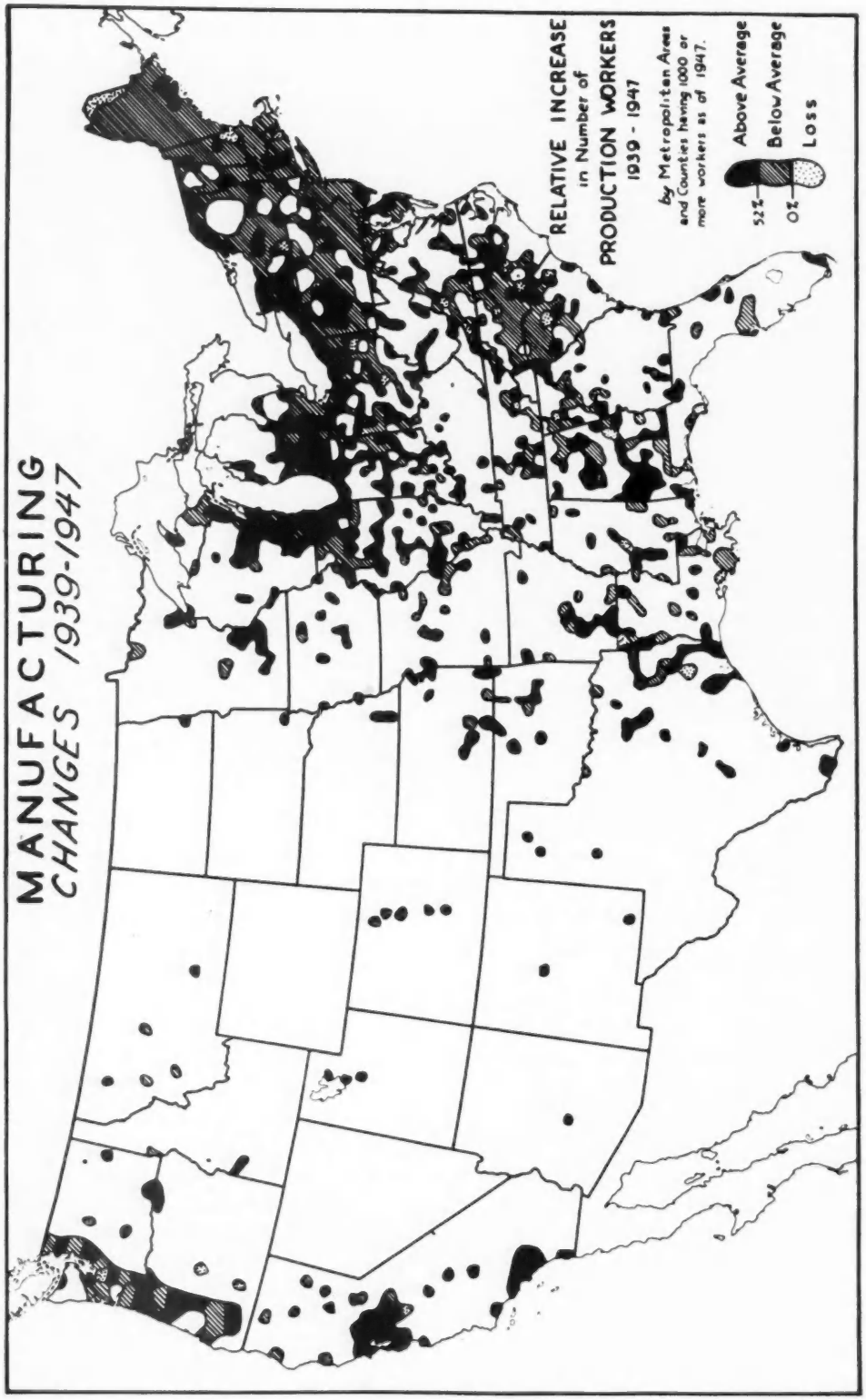
MANUFACTURING
CHANGES 1939-1947
RELATIVE INCREASE
in Number of
PRODUCTION WORKERS
1939 - 1947
by Metropolitan Areas
and Counties having 1000 or
more workers as of 1947.
Above Average
Below Average
Loss
52%
0%

FIG. 3.

The South, likewise, experienced its most rapid growth in the west. Virginia, the Carolinas, and Georgia are characterized by slowly growing counties.

Most of the southern counties represented by solid black on Figure 3 are dispersed. The South has no wide expanse of rapidly growing areas. To be sure, isolated localities such as Houston are conspicuous, but in terms of industrial growth Figure 3 shows clearly that the South lacks a counterpart of the western Great Lakes states. As a matter of fact, counties which experienced a loss in production workers are most numerous in the South. From Texas through the Piedmont states there are 17 counties dotted on Figure 3; Northeastern United States had only eight such counties. There were none in Michigan, Indiana, Illinois, and Wisconsin. (The reader again is reminded that only "industrialized counties" are shown on Figure 3; that is, those which were arbitrarily selected as having 1000 or more production workers in 1947.)

West Coast industry did not expand rapidly over as wide an area as many people think. To be sure, a few areas grew at fabulous rates, but a considerable portion of the West Coast lagged behind the nation's rate, and four counties *lost*.

Counties in western United States have been treated somewhat differently on Figure 3. Since some counties are very large, some covering a greater area than Connecticut, or Massachusetts, or other New England states, it would distort the visual impression of the map to shade in the entirety of these western counties. This is especially true where the county barely qualified as "industrial" in this study because of the presence of perhaps 1200 factory workers in a small community. Therefore on Figure 3 the shading in large western counties has been applied only to an area proportionate to the average area

TABLE III

RELATIVE INDUSTRIAL GROWTH IN METROPOLITAN AREAS 1939–1947

Rank	*Percentage gain*	*Thousands of production workers*		
		1939 Total	*1947 Total*	*Absolute gain*
1. Los Angeles	122	127	281	154
2. Houston	108	22	46	24
3. Erie	100	19	38	19
4. Dayton	98	40	79	39
5. Minneapolis–St. Paul	92	49	94	45
6. Akron	88	40	75	35
7. Indianapolis	88	38	72	34
8. Toledo	86	30	56	26
9 Seattle	85	24	44	20
10. Peoria	79	19	34	15
11. Springfield–Holyoke	76	38	67	29
12. Grand Rapids	76	24	42	18
13. Milwaukee	75	80	141	61
14. Louisville	75	35	61	26
15. Syracuse	72	25	43	18
16. San Francisco–Oakland	70	77	131	54
17. Cleveland	69	129	218	89
18. Columbus, Ohio	68	25	42	17
19. Hartford	66	31	52	21
20. Canton	66	28	47	19

Source: United States Census of Manufactures, 1947.

TABLE IV

AMERICA'S LARGEST INDUSTRIAL AREAS

	1947 Production workers (000)	*1939–1947 Increase in production workers (000)*	*1939–1947 Percentage gain*
1. New York	1,274	407	47
2. Chicago	756	278	58
3. Detroit	466	151	49
4. Philadelphia	437	116	35
5. Pittsburgh	284	93	48
6. Los Angeles	281	154	122
7. Cleveland	218	89	69
8. Boston	215	57	35
9. St. Louis	200	74	59
10. Buffalo	149	58	64
11. Milwaukee	141	61	75
12. Baltimore	138	32	30
13. Providence	131	36	37
14. San Francisco–Oakland	131	54	70
15. Cincinnati	108	36	50

Source: United States Census of Manufactures, 1947.

of counties in the eastern half of the country.

It is in terms of *relative growth* that the South and West Coast can claim certain honors of leadership. By this criterion Los Angeles and Houston rank ahead of all other American cities. Table III lists the 20 *fastest growing* industrial areas selected from the 50 *largest* industrial areas. Los Angeles led with 122 per cent, Houston was second with 108 per cent. Erie, Pennsylvania, ranked third with 100 per cent. Many readers, impressed by publicity about speed of industrial expansion in Houston, may be surprised to see that Erie and Dayton grew almost as rapidly as Houston and that Dayton also grew *more* (column 4 of Table III). No other large industrial area's growth approached 100 per cent.

The misconception that unusually rapid growth is widespread in southern metropolitan areas is exposed when certain facts are presented. If Table III were continued it would show Atlanta ranking 26 with a 60 per cent growth, Birmingham 28 with 56 per cent, and New Orleans 35 with 49 per cent—less than the national rate!

However, Table III has been compiled from only the 50 *largest* industrial areas, and less than half a dozen of these are in the South; therefore the South could not have many representatives in Table III. When *all* the counties represented on Figure 3 are considered, the South appears much more strongly. There are 71 southern counties—mostly small ones—where industrial growth exceeded 100 per cent; the North had only 61 counties of such increase. ("South" here includes the South Atlantic, East South Central, and West South Central States. "North" is used to refer to the West North Central region and all states to the east.) More impressive was the number of 20 southern counties exceeding 200 per cent; the North had only six such counties. The conclusion is that there was a noticeably high rate of growth in the less industrialized southern counties.

Before proceeding to the discussion of changes in individual industries the reader may wish to refer to a summariz-

ing table of the changes in the nation's largest industrial areas. Table IV ranks them according to size but also identifies each by amount of growth and rate of growth.

C. Types of Industries

Just as certain industrial areas grew more than others, so certain industries grew more than other industries. The United States Census of Manufactures classifies manufacturing into 20 groups of industries. Nine of these grew more rapidly than the nation's industry as a whole; eleven grew more slowly (Table V). Figure 4 is a graphic representation of the growth of industrial groups.

Metal industries experienced the greatest growth. The six industries in this group expanded at a rate of 93 per cent. The fastest growing were the two divisions of machinery fabrication: electrical machinery (157 per cent) and non-electrical machinery (132 per cent). Every phase of metal manufacture except the primary industry exceeded the nation's rate of 52 per cent. This boom in metal working has given it a larger share in the nation's industrial structure; in 1939 metals represented only 33 per cent of the nation's employment in manufacturing but in 1947 their proportion was 41 per cent (Figure 5 and Table V).

Only three of the other general groups of industries grew more rapidly than the country's over-all industry: rubber (77 per cent), chemicals (69 per cent), and

TABLE V

LEADING UNITED STATES INDUSTRIES BY THOUSANDS OF PRODUCTION WORKERS

	1947		*1939*		*Gain 1939–1947*	
	Number	*Per cent of U. S.*	*Number*	*Per cent of U. S.*	*Absolute*	*Per cent*
TOTAL	11,916	100	7,808	100	4,108	52
Metals						
Machinery	1,244	11	536	7	708	132
Primary metals	1,010	9	672	9	338	50
Transportation equipment	987	8	545	7	442	81
Fabricated metals	823	7	451	6	372	82
Electrical machinery	639	5	248	3	391	157
Instruments	182	1	85	1	97	114
(Total, Metals)	4,885	41	2,537	33	2,348	93
Fabrics						
Textiles	1,147	10	1,081	14	66	6
Apparel	973	8	753	10	220	29
(Total, Fabrics)	2,120	18	1,834	24	286	15
Foods	1,099	9	802	11	297	37
Woods						
Lumber	596	5	423	6	173	40
Furniture	283	2	189	2	94	49
(Total, Woods)	879	7	612	8	267	43
Chemicals	466	4	275	3	191	69
Printing, publishing	438	4	324	4	114	35
Stone, clay, glass	405	3	267	3	138	51
Paper	389	3	270	3	119	44
Leather	348	3	327	4	21	6
Rubber	214	2	120	2	94	77
Petroleum and coal products	169	1	107	1	62	57
Tobacco	103	1	87	1	16	18
Miscellaneous	397	4	241	3	156	64

petroleum and coal products (57 per cent).

A few industries had low rates of growth and lagged far behind the others: leather (6 per cent), textiles (6 per cent), tobacco (18 per cent), and apparel (29 per cent).

The greatest loss in proportion of total industrial employment was experienced by the textile and apparel groups which represented 24 per cent of United States manufacturing in 1939 but only 18 per cent in 1947. This slow growth cost textiles the leadership in American industry. In 1939 they ranked first with 1,081,000 production workers. A slight increase of only 66,000 raised their total to 1,147,000. But machinery with only 536,000 in 1939 added 708,000 to take over the Number 1 position with 1,244,000 workers.

As a result of these changes, the industrial structure of the United States as of 1947 shows metals to be of increasing importance with machinery the new leader among the industrial groups (Figure 5).

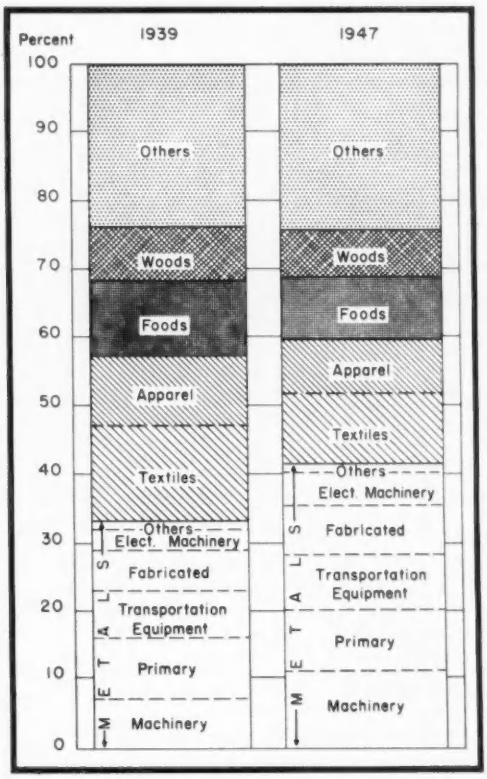

FIG. 5. Industrial structure of the United States, 1939–1947, by number of production workers.

II. CHANGES IN MAJOR REGIONS

It has been pointed out in the foregoing discussion that the various regions in the United States have experienced varied types of changes. Table VI lists the major Census regions in order of *amount* of industrial growth. Figure 6 shows the location of these regions and *amount* of gain in each. Figure 7 compares them according to *rate* of gain. Figure 8 compares them according to 1947 industrial structures.

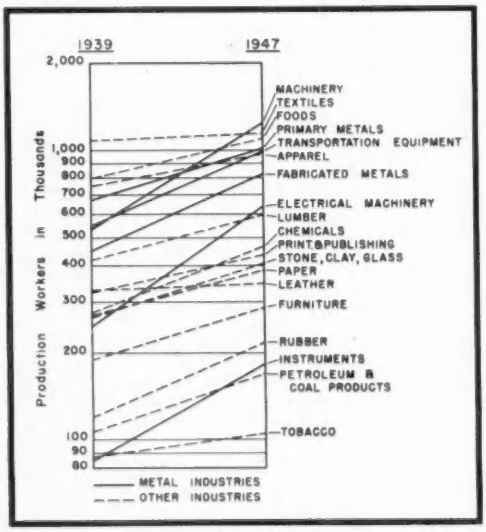

FIG. 4. Growth of industrial groups, 1939–1947, by number of production workers.

The East North Central Region is the largest of the nine industrial regions designated by the Census of Manufactures. With 3,565,000 production workers it contains 30 per cent of American industry.

The 1,384,000 production workers added to factory payrolls in this region was larger than the growth in any of the other eight regions. Moreover, this region contains 10 of the 31 cities listed

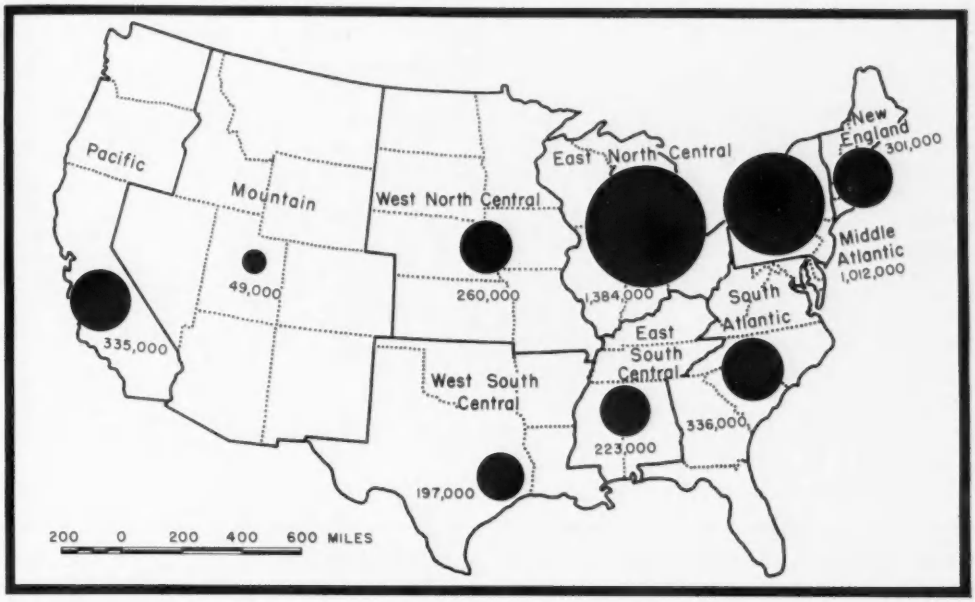

FIG. 6. Growth of manufacturing in major regions, 1939–1947, in number of production workers.

in Table I, the cities which led the nation in *amount* of growth.

In 1939 the East North Central Region contained only 28 per cent of the nation's total industry. Increasing this share to 30 per cent involved a 63 per cent growth between 1939 and 1947. In doing so, the East North Central Region overtook the Middle Atlantic Region as the nation's leader (Figure 7). Figure 3 reveals that most of East North Central's growth occurred in those counties around the southern portion of Lake Michigan, in southern Michigan, northern Indiana, and Ohio.

The individual industries responsible for this region's growth are listed in Table VII which shows for each region: (a) the industries which grew the *most* (absolute growth), and (b) those which grew the *fastest* (relative growth).

The five industries experiencing the greatest growths in the East North Central Region were all metal industries. Similarly, the two leaders in percentage of growth were metal fabricators. In 1947 this region had become more "metalized" than any of the other eight regions (Figure 8). Its leading industry is machinery which employs over 616,000 production workers making this the machinery heart of the United States.

The *Middle Atlantic Region's* increment of 1,012,000 production workers was surpassed only by that of the East North Central. However, only five of the 31 cities which grew the most (Table I) are here.

This was one of the three regions to grow less rapidly than the nation. In fact, its 45 per cent rate was exceeded considerably by the 63 per cent of the East North Central states to whom it relinquished the position of national leadership (Figure 7). Moreover, its share of all United States industry slipped to 27 per cent.

Machinery (electrical and nonelectrical) led all other industries in both absolute and relative growth (Table VII). However, the region's two largest industries are still apparel and primary metals (Figure 8).

The *South Atlantic Region* ranks third

TABLE VI

GROWTH OF MANUFACTURING IN MAJOR REGIONS IN TERMS OF PRODUCTION WORKERS

	Gain 1939–1947		*1939*		*1947*	
	Number (000)	*Per cent*	*Number (000)*	*Per cent*	*Number (000)*	*Per cent*
UNITED STATES	4,108	52	7,808	100	11,916	100
East North Central	1,384	63	2,181	28	3,565	30
Middle Atlantic	1,012	45	2,234	29	3,246	27
South Atlantic	366	37	978	12	1,344	11
Pacific	335	81	411	5	746	6
New England	301	32	947	12	1,248	10
West North Central	260	69	376	5	636	5
East South Central	203	57	355	5	558	5
West South Central	197	76	259	3	456	4
Mountain	49	73	67	1	116	1

in both amount of growth and amount of industry (Table VI). However, it is losing ground. Its 37 per cent rate of expansion was lower than all others except New England. Furthermore, it has only one city (Baltimore) appearing among the growing industrial areas (Table I). The 366,000 production workers added to this region's employment was smaller than the number added by the New York City industrial area alone.

The region's largest industry, textiles (Figure 8), also was the one to grow the most (Table VII). Although this was only a 16 per cent growth it nevertheless exceeded the 6 per cent growth of textiles in the nation as a whole (Table V). The region's second largest industry, lumber, also ranked second in number of additional production workers. By expanding at a 47 per cent rate it also exceeded the national average in that industry (43 per cent).

However, the fastest expansion in the South Atlantic was, again, in electrical machinery (423 per cent) and other machinery (140 per cent).

By adding 335,000 production workers to its industrial manpower, the *Pacific Coast* made the fourth largest advance. However, in rate of growth this region led all the rest. Its average of 81 per cent was far ahead of the national average.

The nation's fastest growing large industrial city (Los Angeles 122 per cent) is here. Moreover, Los Angeles enjoyed the third largest absolute growth, being exceeded in this respect only by New York and Chicago. Table I and Figure 1 also reveal considerable growth in San Francisco–Oakland and Seattle.

Numerous industries enjoyed a healthy growth; all exceeded their national rates; and some experienced amazing rates of expansion (Table VII).

New England industry is not fading away, contrary to some popular misconceptions. A region which has 947,000 production workers and adds 301,000 can hardly be said to be withering on the vine. Moreover, *seven* of the nation's 31 industrial areas which grew most (Table I) are in New England, and *five* of these enjoyed an expansion greater than the 23,000 growth in Harris County, Texas (Houston), about which so much has been heard since it led the South's industrial expansion.

It is in rate of growth that New England lagged behind all the other regions. Its 32 per cent rate was considerably below the national average of 52 per cent and was far outstripped by the Pacific Coast's 81 per cent.

New England manufacturing is going

TABLE VII

REGIONS BY LEADING INDUSTRIES IN GROWTH, 1939–1947, IN TERMS OF PRODUCTION WORKERS

Leaders in ABSOLUTE growth		*Leaders in RELATIVE growth*	
	Thousands		*Percentage*
UNITED STATES, Total	4,107		52
1. Nonelectrical machinery	1,244	1. Electrical machinery	157
2. Textiles	1,147	2. Nonelectrical machinery	132
3. Foods	1,099	3. Instruments	114
4. Primary metals	1,010	4. Fabricated metals	82
5. Transportation equipment	987	5. Transportation equipment	81
EAST NORTH CENTRAL, Total	1,384		63
1. Nonelectrical machinery	349	1. Electrical machinery	170
2. Transportation equipment	187	2. Nonelectrical machinery	131
3. Electrical machinery	169	3. Chemicals	88
4. Fabricated metals	158	4. Fabricated metals	85
5. Primary metals	153	5. Rubber	76
MIDDLE ATLANTIC, Total	1,012		45
1. Nonelectrical machinery	154	1. Electrical machinery	136
2. Electrical machinery	127	2. Nonelectrical machinery	133
3. Apparel	122	3. Instruments	105
4. Fabricated metals	89	4. Transportation equipment	82
5. Primary metals	87	5. Fabricated metals	76
SOUTH ATLANTIC, Total	366		37
1. Textiles	65	1. Electrical machinery	423
2. Lumber	42	2. Nonelectrical machinery	140
3. Foods	36	3. Instruments	122
4. Apparel	27	4. Transportation equipment	78
PACIFIC COAST, Total	335		81
1. Transportation equipment	74	1. Instruments	280
2. Foods	36	2. Electrical machinery	278
3. Nonelectrical machinery	31	3. Transportation equipment	233
4. Fabricated metals	30	4. Nonelectrical machinery	202
5. Lumber	30	5. Rubber	179
NEW ENGLAND, Total	301		32
1. Nonelectrical machinery	81	1. Electrical machinery	118
2. Electrical machinery	41	2. Nonelectrical machinery	98
3. Fabricated metals	34	3. Transportation equipment	81
4. Transportation equipment	17	4. Chemicals	65
WEST NORTH CENTRAL, Total	260		69
1. Foods	51	1. Electrical machinery	243
2. Nonelectrical machinery	44	2. Transportation equipment	224
3. Instruments	28	3. Nonelectrical machinery	168
EAST SOUTH CENTRAL, Total	203		57
1. Lumber	32	1. Transportation equipment	290
2. Foods	21	2. Nonelectrical machinery	257
3. Primary metals	18	3. Instruments	192
WEST SOUTH CENTRAL, Total	197		76[a]
1. Foods	28	1. Transportation equipment	534
2. Transportation equipment	23	2. Primary metals	211
3. Lumber	23	3. Chemicals	138
MOUNTAIN, Total	49		73[b]
1. Foods	10	1. Nonelectrical machinery	210
2. Primary metals	8	2. Fabricated metals	175
3. Lumber	6	3. Chemicals	139

[a] Three industries with high rates of growth are not listed here because their 1939 employment was extremely low, actually less than 1000 production workers. These industries and rates of growth are instruments 1267 per cent, leather 315 per cent, and electrical machinery 248 per cent.

[b] Five industries are omitted from this list because their 1939 size was less than 1000 production workers: electrical machinery 878 per cent, transportation equipment 389 per cent, instruments 312 per cent, paper 205 per cent, and leather 185 per cent.

through a pronounced transition. Textiles still are the major industry (Figure 8) but they are barely holding their own. Their growth between 1939 and 1947 was only .05 per cent. Machinery production is making rapid strides and now constitutes New England's second largest phase of manufacturing. Electrical machinery was the only major phase of the region's manufacturing to exceed a 100 per cent rate of growth.

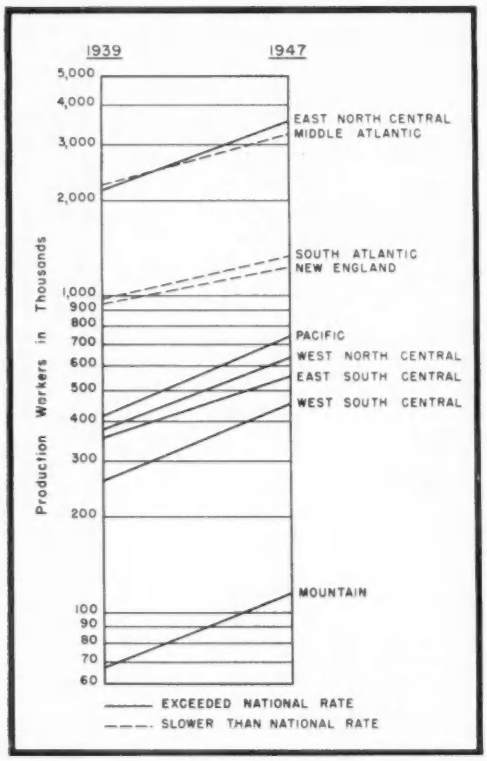

FIG. 7. Growth of industrial regions, 1939–1947, in number of production workers.

The sixth largest expansion was in the *West North Central Region* where the number of production workers increased 260,000. Yet this was less than the growth in the Chicago industrial area alone.

The three metropolitan areas to grow the most were St. Louis, Minneapolis–St. Paul, and Kansas City, all of which rank among the nation's leaders in amount of growth (Table I). Furthermore, the Minnesota Twin Cities had an extremely rapid rate of growth; their 92 per cent rate was exceeded by that of only four metropolitan areas (Table III).

Manufacturing in the *East South Central Region* had an increment of 223,000 production workers.

Only one city of large growth (Louisville in Table I) is here. However, the relative growth (57 per cent) was above average.

Wood products and textiles comprise the bulk of the region's industry (Figure 8). Both industries grew faster than their national averages, but the most impressive relative growths were in transportation equipment (290 per cent) and machinery (257 per cent).

The *West South Central Region* added 197,000 people to factory payrolls. This growth was less than half that of the New York City Industrial Area alone (407,000); it also was less than Chicago's (278,000). As has been indicated the area which grew the most in this region was Harris County, Texas (Houston), which added 23,000 production workers, a figure similar to that for Kansas City, and three separate New England counties (Table I).

In relative growth the story is different. The Southwest's 76 per cent was outstripped by only the Pacific Coast's 81 per cent. Similarly, Houston's 108 per cent expansion was surpassed by only Los Angeles among the large industrial areas (Table III).

Food and lumber industries still are the largest industries in the West South Central Region (Figure 8) and posted the largest absolute growths. However, transportation equipment grew as much as lumber. Of the industries which were not insignificant in 1939, the most rapid increases occurred in metal and chemical manufacturing.

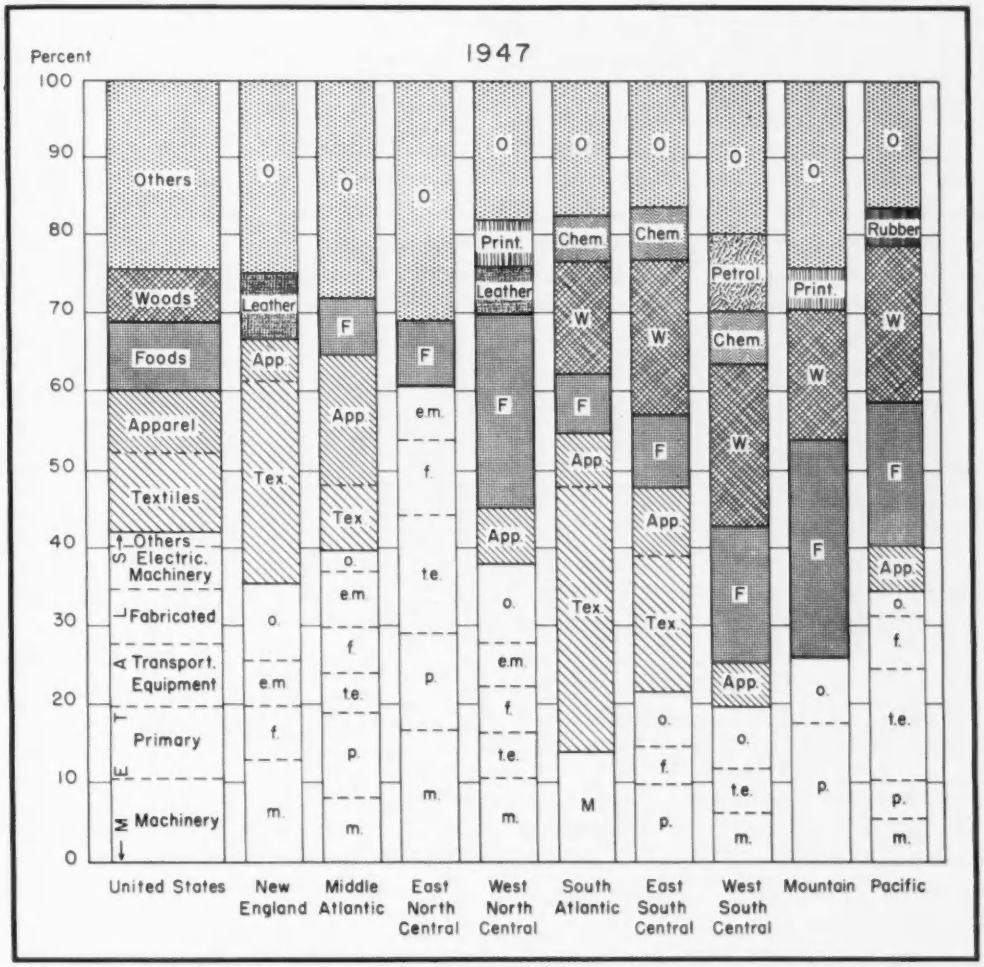

FIG. 8. Industrial structures, 1949, based on number of production workers.

The *Mountain Region* added 49,000 production workers, only slightly more than the growth of Minnesota's Twin Cities. Nevertheless, this represented a percentage increase of 73, a rate surpassed by only that of the Pacific Coast and the Southwest. Foods, primary metals, and lumber grew the most; but machinery, fabricated metals, and chemicals grew the fastest (Table VII).

SUMMARY

In the period between 1939 and 1947 United States manufacturing increased by over one-half its size in terms of employment. Most of this growth occurred in previously established industrial regions, particularly the main manufacturing belt.

Rates of growth were more rapid in the West. The western section of the main manufacturing belt grew faster than the eastern. Likewise in the South, the western portion grew more rapidly than the eastern. The West Coast had the highest regional rate, but the widest expanse of rapidly growing industrial areas and counties occurred in a belt from northern Ohio through southern Michigan to northern Illinois and south-

eastern Wisconsin. The Atlantic Seaboard from Maine to Florida is lagging behind.

Industries showing largest and most rapid gains were the metals. By means of an increase of 2,348,000 production workers they boosted their share of America's industry from 33 per cent to 42 per cent. Electrical machinery and other machinery expanded most rapidly. They led not only in the nation as a whole but also in most of the individual regions.

The foregoing report on growth of American manufacturing is primarily a statistical measurement of change. Awaiting attention is an interpretation of that change. How was expansion related to pre-existing industry? What factors are interrelated to these changes? Where, within regions, did individual industries expand? Many areas experienced significant changes in their amount of industrial employment, but did the character of their industry change? For example, Minneapolis–St. Paul through the years has had considerable industry which was typical of commercial centers. Is the new industrial development of a nature which qualifies the Twin Cities distinctly as a manufacturing community? These and associated questions can be drawn from this study, but they can be answered only as students of manufacturing go into the field to observe the changes and the factors with which they are associated.

ACKNOWLEDGMENTS

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A CONSUMER ORIENTED CLASSIFICATION OF THE PRODUCTS OF TROPICAL AGRICULTURE

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TROPICAL agriculture has long constituted an important field of investigation within economic geography, but the size and complexity of the subject has made difficult its consideration as a whole. There is a multitude of excellent detailed studies within the field, but there are few generalizations concerning it which can assist the student to conceptualize its broader problems. At the present time this absence of valid general concepts is reducing the effectiveness of efforts by the United States Government to improve the economies and living conditions of tropical countries and territories.

An examination of the geographical literature relating to tropical agriculture shows that almost all studies are either specifically regional or are focused on a single crop or product. The number of agricultural crops which can be produced in the tropics is so great that it is improbable that an administrator would be able to examine each item carefully as a prospective vehicle for the economic development of some tropical land. On the other hand the crops are too diverse to be considered as possessing equivalent potentials. In planning regional programs there is need for a theoretical framework in which to evaluate the prospects of particular projects designed to stimulate economic development after the existing character of the region itself has been analyzed. The classification presented in this paper is offered as a step in relating general economic theory to the specific physical and cultural features of the environment which are characteristic of tropical regions of the world.

The Physical Character of Tropical Environments

That portion of the earth's land surface commonly identified as the tropical realm occupies a distinct and essential position in any consideration of world agriculture. In this discussion, these tropical lands will be defined roughly as those areas in which frost does not occur in the normal year and the growing season for plants is not restricted by low temperatures. An enormous number of economically important plants are, by the nature of their physiology, restricted to environments which, under natural conditions, are to be found only in the tropics. The critical factor restricting these plants to these environments is most frequently the minimum temperature value, but nearly uniform length of day and certain combinations of temperature and humidity may be requisite. Suitable environments can be maintained artificially in other parts of the world, as in the case of the use of smudge pots to protect citrus fruit in Southern California against cold. Except where the amount of environmental alteration is small, however, as in the cited example, the costs of such operations are virtually prohibitive.

In another way the tropical regions have a considerable advantage in meeting human demands for the products of the vegetable kingdom. Assuming all other things are equal, the continuous growing season makes a given piece of land in the tropics an efficient place to expend labor and capital, since its requirements for these investments will be continuous and relatively uniform, and its rewards, in terms of plant growth, can be without interruption.

It will be admitted that the tropical lands do contain large areas where the soils are difficult to utilize, and, in some cases, completely unmanageable. However, such extreme conditions actually exist only in a relatively small fraction of the total area. There are many places, too, particularly in Southeast Asia, where heavy yields are obtained in each of two or three crops per year. It would seem unreasonable to assume that all the potentially good land is fully occupied. The development of banana plantations in what had been virtual wastelands on the margins of the Caribbean little more than a generation ago indicates that many little-used tropical lands can be productive if there is an adequate incentive to make them so.

ECONOMIC CONDITIONS AND PROBLEMS IN TROPICAL LANDS

At present there are few tropical areas where standards of living for the existing population are anything but low. This applies to densely populated, highly productive Java as well as to sparsely populated areas such as the Amazon Basin. In either case the low per-capita consuming power of the population is a direct function of its low per-capita producing power. This low producing power, in turn, stems from the absence of the capital equipment which characterizes the more prosperous agricultural regions of the mid-latitudes.[1] A striking example of the contrast between the two agricultural patterns is provided by comparing a Javanese rice farmer with a wheat grower of Western Kansas. The greater food production per hour of labor on the part of the latter parallels closely the greater amount of equipment and inanimate energy he controls.

Assessing blame for the failure of most of the tropical regions to amass capital while certain areas in the mid-latitudes were doing so is not the purpose of this paper. Areas which did amass capital equipment capable of enhancing agricultural productivity do enjoy higher standards of living for both the rural and urban populations. This is true both for the relatively few areas in the low latitudes where the situation applies, such as the São Paulo coffee-producing region of Brazil or some of the sugar plantations of Central Cuba, and for the more prosperous agricultural regions in the mid-latitudes.

THE PROBLEM OF PROVIDING EFFECTIVE AID TO UNDERDEVELOPED AREAS

The stated policy of the United States Government is now directed toward raising living standards in the world's so-called underdeveloped areas. It is now rather generally accepted that this policy is desirable not only from a humanitarian standpoint and to insure reasonable political stability, but also because regions with low living standards are poor markets and tend to act as a dead weight on the economy of the world as a whole.

The question of how to raise standards of living in the underdeveloped areas, however, is anything but settled. Loans

[1] A summary of this situation is offered by S. W. Boggs, "Mapping Some of the Effects of Science and Technology on Human Relations," *Department of State Bulletin*, Vol. XII, No. 294, Feb. 11, 1945.

made or guaranteed by the United States Government are receiving considerable attention. This may be the quickest way of initiating progress in the desired direction, but the appropriation and expenditure of money provides no assurance that any permanent benefits will accrue. For a time, particularly in the present world political climate, it is possible that loans may be made without expectation of repayment, but they can hardly be expected to continue on this basis. Nor is it probable that the United States will long find it has an interest in financing the development of high-cost, local industries which require tariff protection and which, while they increase the self-sufficiency of the country in which they are located, actually raise prices, lower living standards, and reduce that country's participation in world trade.

A significant benefit to living standards can be obtained from loans, whether of governmental or private origin, only if they are invested in productive capital which will increase the output of an hour's labor in some commodity for which there is a market. If this situation obtains, there can be a gain in individual consumption, and some of the increased income can be utilized to repay the loan and later to make further capital investments. In other words, the community will be moving in the direction of economic progress.

It then becomes pertinent to examine the fields in which productive capital may be invested from two standpoints. First, will this economic activity respond to capital investment with increased yield per unit of labor, or will there be merely an expansion of production proportional to the addition of more labor? Second, will there be a market for expanded production of the commodity without a price decline which would wipe out the gain in labor productivity? There appear to be two fields where capital investment in the tropical regions may meet the above specifications. The production of minerals is one, but this activity is restricted to the relatively few localities where economically workable mineral deposits occur. The other field is agriculture, where the characteristic features of tropical climates afford particular advantages to these areas in the production of certain crops.

It must be recognized that in many of the most critically poor tropical areas investment of capital in agricultural activities will not suffice to improve living conditions more than temporarily. In parts of Asia and in certain of the West Indies the labor supply is so abundant and arable land so limited that mechanization of agriculture probably would not increase production, but only increase unemployment. In such localities industrialization and perhaps emigration may be necessary. However, industrialization in tropical lands, if it is eventually to become independent of donations from abroad, has many drawbacks. For a long time, only those industries which use relatively unskilled labor and pay low wages can compete in world markets with established suppliers. The effect of such industrialization may be no more beneficial than that of replacing rural slums with even more squalid urban ones. Similarly, emigration will achieve only the most transitory benefits, if any, unless there is an attack on the basic problem of accelerating population increase.

That tropical regions enjoy advantages in agricultural production has long been recognized and exploited. For many years the crucial problem has been the marketing of their produce at a satisfactory price. In such important commodities as coffee, cane sugar, and rubber, all sorts of production and marketing restrictions have been instituted

to the end of maintaining a high price structure. Prior to making gifts, loans, or investments to increase crop production as a means of improving local economic conditions, it is desirable to ask certain questions concerning particular agricultural products of the tropical regions. These questions are: Will the cost of production of the crop be reduced by the application of the machinery and improved technology which capital investment can provide? Will this cost reduction be sufficient to make possible a price reduction to permit sale of the additional product, and at the same time increase the income and hence improve the living standards of the workers employed? Is the market for the crop sufficiently elastic to be stimulated by a moderate price reduction into absorbing the new production which the proposed capital investment is designed to bring about?

CLASSIFICATION OF THE PRODUCTS OF TROPICAL AGRICULTURE

As an approach to answering the above questions a classification is proposed. It attempts to group the products of tropical agriculture in terms of how they meet consumer needs and satisfy wants and as to their competitive position with respect to commodities from other sources. While no classification scheme is likely to provide a definitive answer to specific questions of economic and social policy, it is hoped that this one will have some utility in focusing attention upon the enormous importance of the relative marketability of individual products as one of the principal criteria of their potentialities in providing a basis for the economic development of localities which can produce them. The proposed classification follows:

I. Products of plants which grow exclusively in the tropics and possess properties which cannot be duplicated or satisfactorily approximated in the mid-latitudes, and for which a demand already exists on the part of consumers in the mid-latitudes.

II. Products which compete with equivalents or substitutes produced in the mid-latitudes; the tropical product is able to enter mid-latitude markets because it can be produced more cheaply or possesses small qualitative distinctions which give it an advantage in the market place.

III. Products which do not enter mid-latitude markets; they may be consumed locally or sold elsewhere within the tropics.

By considering products in terms of the above categories, it is hoped that certain insights as to their marketability can be obtained, and that reasonably valid generalizations can be drawn as to the potentialities of certain products as bases for the economic progress of certain tropical lands.

Category I—Peculiarly Tropical Products Sold in the Mid-Latitudes

The earliest commercial relations between mid-latitude and tropical regions were established as a result of an intense desire on the part of the former areas to obtain those products which, at the time at least, fell in this class. Spices, sugar, tobacco, cacao, cotton, and indigo are some of the products, the desire for which induced Europeans to explore the world in the 15th and 16th Centuries and to develop such complex institutions as the plantation system. Many peculiarly tropical crops still enjoy intense demand in the world market and constitute a significant share of the exports of the tropical regions. These crops include coffee, several of the most important spices, cacao, bananas, pineapples, etc. Their production has long been geared to the export market, and, in most cases, is sufficient to saturate or even oversupply the market at the present price structure. The production of many commodities in this category—for example, bananas—has already attracted heavy capital investment and enjoys

considerable efficiency. Unless some drastically new technology were to be introduced, further investment might only increase the financial burden of fixed charges and raise production costs, even though an oversaturation of the market might lower prices temporarily, that is, until some producers were forced out of the business. Frequently, the market is inelastic; for example, it is hard to imagine how any price reduction would increase significantly the consumption of pepper in the United States.

At an accelerating rate, the tropical regions have been losing their position as the exclusive source of those products which have the greatest market potential in the mid-latitudes. This loss began in the 16th Century with the transplantation of tobacco. Two recent occurrences have been the development of more or less satisfactory synthetic substitutes for rubber and quinine. At present, the plant breeder and explorer, and the industrial chemist and technician, are receiving strong support from interested governments in their efforts to destroy this exclusive position of the tropical lands in regard to other products. The effect of such a change is not always the same. Sometimes, as when aniline dyes replaced indigo and other natural dyes, an industry was destroyed. The cotton gin, making possible the use of the hardier Mexican Upland cottons, drove all but the long staple specialties of the tropics into a much tighter competitive position. The sugar beet has not removed cane sugar as an important tropical product, but has definitely placed it in Category II. It would not seem desirable to invest too much money, much less the stability of a country's economy, on the assumption that a tropical crop will not suffer sudden and violent competition from another source. Those products which are most strictly luxuries are subject to another risk. The fad which established their market may be replaced by another which will destroy it. The effect of changing hat styles on the ostrich plume market and the decreasing consumer interest in nutmeg in the past century exemplify this problem.

On the other hand, many tropical crops have not yet found a mid-latitude market. Some—for example, bananas and pineapples—have only recently gained one and are already major exports. It is reasonable to expect that there will be a continuous introduction of new elements from the rich vegetal resources of the tropical regions into the patterns of consumption of people of the mid-latitudes. Sometimes this may require the application of new processing techniques; in other cases the major expense may be the promotion of a market by effective advertising. These new products may well justify limited investments.

Category II—Competing Tropical Products

Those products which are competing effectively with mid-latitude equivalents appear to have much brighter prospects. Sugar and palm oil are excellent examples. In many cases the products in this class supply absolutely essential elements in the consumption patterns of the mid-latitude countries. The fact that there is competition in the market place from local products may be advantageous rather than harmful. It forces the tropical producer to develop the same efficiency in production as the mid-latitude producer, to maintain at least comparable quality control, and to utilize the climatic and biotic potentialities of the tropical environment in order to compensate for greater transfer costs and still allow a profit margin. The mechanization and high efficiency of Cuban sugar production probably would

not have been achieved, nor would sugar have its place as a cheap staple in the diets of most mid-latitude residents, had beet sugar not forced the tropical cane sugar producers to change from low output at high profit for a semi-luxury market to quantity production at low cost for a mass market.

Products of tropical regions have entered this category from two sources. This may have occurred through the development of a new equivalent, either a synthetic or a plant sufficiently hardy to grow in extra-tropical environments, or the tropical product may have entered the mid-latitude market as a cheaper or qualitatively superior commodity in competition with established, locally-produced commodities. An example of the latter development is the sale of palm oil and palm kernel oil in Europe in competition with the local animal and vegetable fats and oils. War and blockade have shown the extent to which European living standards are dependent on this import which only supplements local production.

Within the past 75 years the non-Asiatic markets for tea have been captured from the subtropical regions of South China and Japan by truly tropical lands such as Indonesia, India, and Ceylon. The reasons for this success of the tropical producers are not entirely environmental, but include such elements as colonial governments which facilitated the institution of plantations with their stricter quality control, and the lack of taste discrimination on the part of Occidental consumers which made them unwilling to pay premium prices for the choicest subtropical teas. The tropical tea plantation, however, owes a major portion of its success to its exploitation of the more rapid plant growth, the more frequent pickings, and the longer—in some cases continuous—picking season permitted by some tropical climates. Utilizing these advantages, the tropical plantation was able to put tea of controlled, if not exceptional, quality on the export market at lower prices than could the established producing areas of China and Japan. It is probable that the plantations of India and Indonesia will give way to locally controlled enterprises, but these producing areas are likely to continue to dominate the export market.

The important position of tropical agricultural imports in mid-latitude economies, in cases where the import can be produced locally as well, is a relatively recent development which had to be preceded by the development of cheap bulk transport. Ocean shipping is still the dominant vehicle for this movement. In a few instances, where the market is sufficiently wealthy, the airplane is carrying perishable, out-of-season vegetables, fruits, and flowers from the tropics into the mid-latitudes.

Unfortunately, as modern technology is making it easier for the mid-latitudes to procure agricultural products from the tropics, modern political attitudes are creating barriers to this procedure. All too many mid-latitude countries are placing heavy tariffs and rigid import restrictions on commodities which can be produced in or replaced by products of the national territory. Certain justifications for these actions may be valid. Maintaining access to strategic supplies in time of war may be among them. If this is the consideration, it is well to deal with military realities and not confuse them with protecting vested interests. The accessibility of Cuban sugar to the United States is a case in point. It is to be hoped that the nations of North America and Western Europe, if they are interested in the welfare and good will of the peoples of the tropical parts of the world, will endeavor to make themselves more accessible mar-

kets for the agricultural products of these regions. Their economies are too deeply involved in world trade to permit an arbitrary refusal to trade in particular commodities without some damage to themselves and more to their international relations.

The market for efficiently produced staple crops to be sold in the mid-latitudes is not saturated. The demand for meat is pressing United States farmers to supply the local market. Western Europe's consumption of this commodity is kept below the level desired by the population, primarily by price. This demand could be exploited by tropical regions, either through direct production of meat of such quality that it can be transported to and sold in Europe or by exporting cheap fodder which will permit an increased number of livestock in the consuming area. The rapidity of vegetative growth in the rainy tropics makes this area an ideal place for the production of cellulose for the expanding chemical synthetics industry. Silviculture for lumber and paper pulp offers further commercial potentialities. Southeastern United States has found more prosperity after losing its dominant position in the world cotton market and diversifying its agriculture than it knew before. The world's demands for cotton are being met to a greater extent by more tropical producing areas. Brazil, Northern Argentina, and East Africa are important among them.

Category III—Tropical Products Which Do Not Enter Mid-Latitude Markets

Those tropical agricultural products which do not enter significantly into world trade tend to receive less attention from commercially-minded investigators than they merit. A list of these crops for all the tropical areas of the world would be of enormous proportions, and range from well-known staples such as yams and manioc to the unfamiliar durian fruit.[2]

The reasons for the absence of these crops from world markets are several. Perishability in transport prevents our enjoying many tropical fruits. Certain starchy staples have not been accepted into mid-latitude dietary patterns. The value of yams and sweet potatoes is scarcely high enough to justify the cost of transportation to mid-latitude markets, even though they probably can be produced most cheaply in the tropics. In the case of rice, there are nearby tropical markets which can easily absorb the relatively few existing surpluses.

Commodities falling into this category may possess the greatest capacity to contribute to the economic betterment of the populations of tropical regions. In the first place, since they have not been objects of interest for traders from economically more advanced localities, less attention has been paid to the application of modern technology in their production. With such application it is reasonable to expect that in many cases the return per hour of labor might be significantly increased.

From this group of commodities there has been a steady introduction of new items into the world's markets. There is no reason to assume that this movement has exhausted all the possibilities. Quick freezing has scarcely been attempted on many potentially attractive tropical fruits. It may yield many profitable trade items to the experimenters. The potentialities of starch

[2] Some appreciation of the wealth of the floristic resources of the tropical lands can be gained by leafing through the 2400 finely printed pages of I. H. Burkill, "A Dictionary of the Economic Products of the Malay Peninsula," Crown Agents for the Colonies, London, 1935. It should be noted that this work is restricted in scope to a very small area and one of rather uniform climatic character. In other phytogeographic and ecologic realms within the tropics there are many more plants of utility to man.

crops which can be grown cheaply and used for such vital products as industrial alcohol are worthy of consideration.

Even should a crop never enter into more than very local trade, its production may still merit capital investment designed to lower production costs in terms of human labor. Low living standards in the tropical regions are closely related to the great proportion of the available labor of a population which must be devoted to the production of that population's food. Freeing a fraction of that labor for activity in other directions and still maintaining the food supply can be enormously beneficial. The additional labor made available may be directed to the production of commodities to be sold in world markets, thus raising per capita income, to industrial activity or processing of commercial crops, or to public works and the elevation of educational standards. These results are the stated goals of American policy in dealing with the underdeveloped tropical regions of the world.

CONCLUSION

It is hoped that this classification of tropical agriculture in terms of the consuming market for its products will be of value to those engaging in specific planning designed to implement this policy as well as to economic geographers attempting to construct an intelligible framework in which to describe the complexities of agriculture in tropical areas.

CANNING IN NORTHWESTERN ARKANSAS: SPRINGDALE, ARKANSAS

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IN Arkansas the canning of fruits and vegetables shows a decided clustering in the northwestern part of the state, an area which constitutes part of a larger canning district including sections of Arkansas, Missouri, and Oklahoma. In this northwestern part of Arkansas, which may properly be called the state's cannery center, five counties are of chief significance (Fig. 1). These five counties, however, differ considerably as to the nature of the canning industry. In Carroll County tomatoes are the only product canned, and in Madison and Boone Counties they are by far the dominant item. Washington and Benton Counties, however, are noted for some diversity in the canning business, with an increasing tendency towards varied products on the part of the more firmly established plants.

Recent Trends

A glance at Table I will reveal the 1950 status of the five leading counties of Arkansas with regard to numbers of different products canned. It will be noted that Washington and Benton Counties have characteristics not only of the previously established one-product system but also of the more recent movement towards a wide range of products. These counties are representative of a general economic trend in this part of the state towards small industrial operations and specialty agriculture, a trend encouraged by relatively good transportation facilities and by a recent population increase in this section.

Commercial canning in northwestern Arkansas is of increasing importance, and is a part of an economic readjustment in this region. In this part of Arkansas for a time it was believed that the future lay in general farming often of a self-sufficing nature, with commercial agriculture largely restricted to apple orchards. Gradually, however, specialization in other forms of farm production has begun to replace this plan. Various types of specialization are being tried, the most important being poultry raising, dairy farming, and small fruit and vegetable production. The rolling to very hilly land, the frost-free season of nearly six and one-half months, and the moderately fertile though often very cherty soil provide a suitable environment for fruit farming which may include a small vegetable production, and for a type of general farming which includes the production of small fruit and vegetables as cash crops. Concurrent with this change in farm activity has been the gradual acquisition of small industrial plants. Commercial canneries with greater and greater diversity of products are, naturally, very important members of the small industry group. Farmers raising fruits and vegetables for cash will of course send some of them to the market fresh. Much of the rest of their output, however, is destined for canneries in

FIG. 1. Member plants of the Ozark Canners Association, 1950. (Information from *Canners Directory*, 1950, Ozark Canners Association, Fayetteville, April, 1950.)

villages or in small urban centers nearby.

THE SPRINGDALE CANNING CENTER

Springdale, in Washington County, is a city representative of a number of small but progressive communities in which commercial canneries are an important factor in the economic structure. A study of the canning industry in Springdale and its vicinity presents a picture reasonably typical of the industry in its somewhat more diversified aspects in Arkansas.

Springdale is located near the center of the northwestern canning district. It is situated on the Springfield Plateau, at an altitude of 1300–1500 feet, the ground rising gently to the southeast. The Springfield Plateau is only moderately dissected north and west of the city and for some 12 miles to the south. Eastward, however, exceedingly rough land begins with the White River drainage area within 10 miles of Springdale, and continues well into the Salem Platform in the eastern part of the state. The accompanying map (Figure 2) gives some idea of this situation. The relative lack of dissection in the part of the Springfield Plateau lying in Washington and Benton Counties has been of great

importance to the development of the canning business, as it has influenced the location of two of the major north-south routes through the state, the St. Louis and San Francisco Railroad and U. S. Highway 71. The easiest route from the Central Plains of the United States to the western part of the Arkansas Valley in Arkansas lies through the northwestern quarter of the state, and this region thus possesses some focal transportation characteristics, a fact of great value. To the canning industry this has meant that the canned product can be moved out readily. It has also meant that fruits and vegetables destined for the canneries can move in, not only from immediately adjacent areas, but also from contiguous regions north, west, and south.

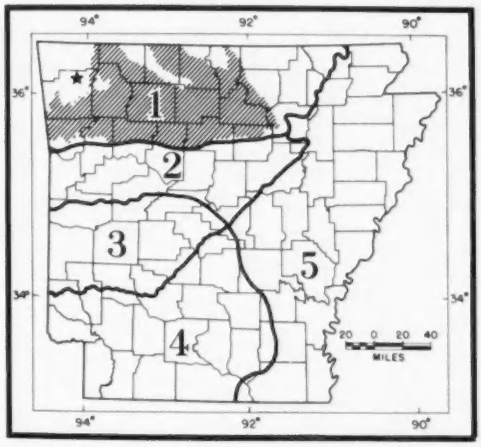

FIG. 2. Landform regions of Arkansas. Numbers have reference as follows: (1) The Ozark Plateaus; (2) The Arkansas Valley; (3) The Ouachita Province; (4) The Gulf Coastal Plain; (5) The Mississippi Alluvial Plain. The area of major dissection in the Ozarks is shaded; location of Springdale is shown by star.

The nature of the canning business in Springdale has changed considerably since the beginnings of the industry there, as is true in other towns of northwestern Arkansas. Canning began in this region about 40 years ago, but at its inception was concerned almost exclusively with just one product, tomatoes, canned for local consumption only. The canneries of that time were very small affairs, often no more than family enterprises. By the mid-twenties, although tomatoes still were the only important product, marketing had extended to the neighboring states, and some canneries had expanded beyond the family cannery aspect. The 1930's saw the real beginnings of diversification in the industry, and the 1940's emphasized this trend. It has been accompanied by the creation of some new plants, the enlargement of some existing plants, and the expansion of the market territory until at present Arkansas canned goods are marketed all over the United States.

Many small tomato-processing plants still exist in tiny rural centers in northwest Arkansas, and tomatoes remain a leading product of the cannery region. However, there are now more than 30 kinds of canned items, and for the larger plants diversification is now the rule. From having occupied a position of monopoly in the industry, tomatoes now usually are in third place in importance. Occupying first and second places are green beans and spinach, respectively. If all the pack of greens is considered—turnip, mustard, kale, and poke greens as well as spinach—that group is now most important.

Springdale is representative of this development in Arkansas, as the plants there have enlarged and diversified, and the leading items processed are the three leaders for the state—green beans, greens, and tomatoes. Other products canned in Springdale are strawberries, various other berry crops such as blackberries, boysenberries, and youngberries, and apples, grapes, and potatoes. Most of the diversification has taken place in the past ten years. Recent population trends in Springdale are of considerable interest. The population

TABLE I

EXTENT OF DIVERSIFICATION IN CANNERIES IN NORTHWESTERN ARKANSAS, 1950

Figures used are those for the member plants of the Ozark Canners Association. (Data from *Canners Directory*, 1950.)

County	*Total number of plants*	*Number with only one product*	*Number with two products*	*Number with three products*	*Number with over three products*
Washington	22	13	2	2	5
Madison	20	17	2	..	1
Benton	16	6	2	1	7
Carroll	7	7	..	..	..
Boone	6	4	2	..	..

graph (Fig. 3) shows that Springdale's rise in population, though steady, was quite moderate from the time of the first census record until 1940. From 1940 to 1950, however, the population showed a sharp rise. This is a reflection of the general growth in the county during that decade, and certainly can be traced in part to the increase in farm specialization which has been encouraged and accompanied by the growing diversity of the canning business.

Springdale has three canneries. One of these, the Welch Canning Company, cannot be considered as truly representative of the usual cannery in northwestern Arkansas, as most of the plants are owned and operated by local people rather than by outside corporations. The other two canneries are locally owned. They are rather modest in size as is typical for Arkansas (Fig. 4). The number of employees in such plants in cities the size of Springdale is usually between 50–100. In the peak of the season, however, there may be three shifts a day, each with 50–100 people.

PRODUCTS AND SOURCE AREAS

If tomatoes were still the only product of all canneries, the canning season would last only about two and one-half to three months. This is the case for the small enterprises which still operate in the country or in villages around Springdale. In Springdale, however, the length of the canning season averages around nine months a year for the locally owned canneries, although it will vary from year to year. Occasionally a plant will operate during every month of the year.

As a rule the canning season opens in the month of April with the spring crop of spinach from the Arkansas Valley, accompanied or closely followed by other greens. In June the local berries and the local early green beans move to the canneries. The berry pack usually does not extend beyond the end of June, but the early beans continue coming until the middle of July. Towards the end of July or the first of August, the tomatoes are ready for the canneries, and their processing continues until frost. Grapes mature some time around the middle of August or a little later, continuing into the early part of September, while the fall crop of local beans and beans from other areas comes in with September and continues to arrive until late October. The fall crop of spinach and other greens is usually ready in November. Irish potatoes may be canned at any time during the year when the market demands them, and when a good supply is available from the state or from areas outside of the state.

The supply territory for the canneries of Springdale varies from the immediately adjacent farm country to districts outside of Arkansas. No boundary can be indicated for the area from which any one product comes if that boundary

is assumed to be inflexible, as at some time there will undoubtedly be a shipment of that particular product from a region outside of the area of major supply. However, it is possible at least to determine these areas of major supply for most crops, with the understanding that the delineation represents merely the average situation.

Products most definitely associated with the northwestern farm area, and produced in the regions adjacent to Springdale, are tomatoes, apples, grapes, and berries. Of these, the most restricted supply area is that of tomatoes. It is safe to say that the tomatoes which move into any cannery in Arkansas come from the countryside within 20 miles of that cannery, and that the chief producing area for each factory is much more restricted than that. Tomato canneries are still more numerous than any other kind in Arkansas, and small canning plants are plentifully distributed through the farm communities. Equipment for this type of canning is inexpensive, and only a little practice is needed to become fairly proficient. During World War I and again in World War II there was a pronounced rise in the demand for canned tomatoes, encouraging many farm families to raise more of them and to start their own canning plants, perhaps in cooperation with one or two other families. Of course the uncertainties of the market following war periods and the more rigid inspection of products have caused a number of these very small factories to go out of business, but that is just as simple a matter as going into business was in the first place, for the tiny plant. With any marked increase in demand, the small tomato cannery, known locally as a "shade tree cannery," starts operating again. As a result, the number of tomato canneries fluctuates widely in northwestern Arkansas, but there is always a goodly number of these small plants operating. In every case, a plant shown as a one-product plant in Table I is processing tomatoes. Obviously, then, there is no need for the fresh product to move any great distance to a cannery.

Springdale, therefore, secures tomatoes from a highly limited supply area. The great majority of the tomatoes used in the city's canneries come from farms within a radius of eight miles. More-

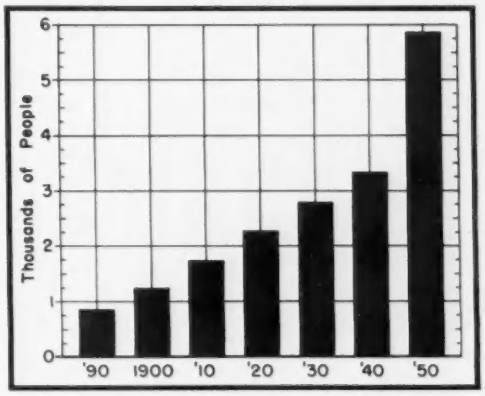

FIG. 3. Population growth of Springdale, Arkansas. (Data from Sixteenth Census of the United States: 1940. Population, Vol. II.)

over, it is estimated that probably half of the tomato pack is secured from farms within a radius of three miles.

The apple supply area for Springdale is almost as restricted. Although apples do not occupy the commanding position in the economy of the region which it was once believed they would attain, northwestern Arkansas is the leading apple region of the state. Most of this fruit is sold on the fresh fruit market and there is little demand on the part of the canneries. Therefore, the requirements of Springdale's canneries are easily met by the orchards within a radius of about 10 miles. The leading varieties of apples are Jonathan and Gano, and as a rule they are canned sliced or quartered.

The supply region for grapes is somewhat more extensive, as it has a radius

of 20 to 25 miles. Quite a large number of the grapes come from a locality much closer than that, however, the "vineyard town" of Tontitown about six miles west of Springdale. This is an Italian settlement, and the people there have concentrated their agricultural activities on the production of grapes. A traditional grape festival is held each August when the grapes are ready, and then much of this fruit moves to Springdale, to be used in the production of grape juice, grape jams and jellies, and wines. In its possession of a winery (Fig. 5) Springdale departs from its role as a typical canning center, for there are only a few wine-making establishments in Arkansas.

The growing of berries is rather widely distributed, but the main supply area for Springdale is relatively localized. Berry production extends from northwestern Arkansas into northeastern Oklahoma, into southwestern Missouri, and south in Arkansas as far as the extreme southwestern corner of the state. Missouri berries seldom come in to Springdale, however, as they are canned almost exclusively in Missouri. Occasionally, berries do move from southern Arkansas and from Oklahoma to the Springdale canneries. The chief supply area, however, lies within 25 or 30 miles. All of these berries represent specialties which bring an extra cash income to the farmer. They are usually not raised as the exclusive product of the farm, but are supplementary to some other type of farming. Arkansas is noted for the sweetness and fine quality of its berries, most of which are cultivated rather than wild, and many of them are sold on the fresh fruit market. The tendency, however, is for an increasing percentage of the small fruit crop to be processed. This was noticeable in strawberry sales in 1950, when for the first time over one-half of the crop was processed as opposed to 15.2 per cent in 1949. Moreover, this was in the face of a larger strawberry crop in 1950. Of course it is undoubtedly true that a part of this change is due to the increased interest in the quick-freezing of berries.[1]

As has been noted, green beans comprise one of the three leading products of the canneries of Springdale. While green beans are raised quite extensively in northwestern Arkansas, the supply area for the canneries extends some distance beyond the northwestern region. The major source area may be delineated roughly as extending south some 65 miles to Fort Smith, eastward over 100 miles to north-central Arkansas in the vicinity of Clinton (Van Buren County), west to Haskell in the Arkansas Valley in east-central Oklahoma, and north to Monnett and Neosho in southwestern Missouri, a distance of about 65 miles. At times, Louisiana and Mississippi also furnish this product. As previously stated, both spring and fall crops are canned. The rise in importance of green beans in the canning industry of Arkansas has been one of the interesting trends of the past 10 to 15 years. The Crop Reporting Service for Arkansas has statistics showing that the acreage of snap beans intended for processing increased five times in the period 1938–1947 over the figure for 1928–1937, and that yield in the 1940's was better than one and one-half times that of the 1930's.[2] Arkansas has become one of the top eight states in the canning of green beans.[3] This development is well illustrated in Spring-

[1] The quick-freezing of berries and of other products is attracting greater attention every year and should be the subject of a separate study.

[2] *Agricultural Statistics for Arkansas*, Report Series No. 13, June, 1949, Crop Reporting Service, Bur. of Agr. Econ. in cooperation with Agr. Exp. Sta., Univ. of Ark., Coll. of Agr.

[3] Sixteenth Census of the U. S.: 1940. Manufactures, Vol. II.

dale, where the past decade has brought increasing emphasis on the processing of this crop, both the beans alone and beans in combination with Irish potatoes. It is true too that in those smaller canneries around Springdale which process two crops, while one is almost always tomatoes, the other is most frequently green beans.

Greens as a group, and particularly spinach, share with green beans the characteristic of steadily increasing importance. Most greens come to Springdale from regions outside of the northwestern cannery district, as only poke greens are obtained in the adjacent farm districts. Spinach occasionally moves in from the Wintergarden area of Texas, but spinach greens as well as turnip and mustard greens all are brought in chiefly from the Arkansas Valley, where production is on farms scattered from Haskell, Oklahoma, to the Mississippi River. In the processing of greens, Arkansas has an important position in the United States, usually ranking first in the canning of greens other than spinach, and in spinach ranking second to California.[4] In spring and again in fall, large trucks laden with the greens move out of the Arkansas Valley and northward on Highway 71 to the various canning centers of the northwest. If the Valley has a particularly open winter, the season may continue through the winter months, and in that event Springdale's canneries will be in operation processing the greens from November to May.

It should be noted that there is comparatively little canning of spinach in the Arkansas Valley where the crop is produced. The bulk of the greens is canned in the northwest because (1) the northwestern district had the advantage of an already established industry and (2) the concentration of canning in northwestern Arkansas provides a decided advantage of convenience in collection, as this area and adjacent sections of Missouri and Oklahoma serve as a focal pick-up area for the van lines of several large concerns.

Potatoes and potatoes canned with green beans are also important products of Springdale. It is not possible to localize the source area for Irish potatoes, as they are brought in from numerous localities both in and out of the state, and no one region seems to have a clear lead. They have come from Texas, Kansas, Louisiana, Mississippi, and Oklahoma as well as from the Arkansas potato fields. The supply area will depend upon the time of the year when there is a demand for the product. The cannery schedule is quite flexible as far as this product is concerned, and potatoes may be canned at various seasons during the year.

BUYING AND SELLING

Most of the crops discussed above move to Springdale by truck transportation. In the early days of canning, products moved by wagon if close in, or sometimes by rail. Now it is probably true that more than 90 per cent of the crops come by motor transportation, the rest by rail. The typical practice is for the sale to be F. O. B. the factory, and usually the farmers supply their own transportation.

At one time it was customary for the canners to enter into contracts with the farmers for purchase of the fresh product. When that system was followed, canners often supplied seed and fertilizer, and stipulated required quality and quantity. This method was found to be unworkable in practice, however. Now the canners usually send out buyers when the fruit or vegetable crop is about ready. Naturally, each canner

[4] Sixteenth census of the United States: 1940. Manufactures, Vol. II.

has certain farmers from whom he habitually buys. This is particularly true for the spinach crop. Nevertheless, nothing in the nature of a written contract exists. At times, too, sales are much more informal for some products. A farmer may simply stop at the cannery and ask whether he can sell a load of potatoes, tomatoes, or berries. If the canner can use the product he examines the load and quotes a price, which may or may not be accepted.

The system used in the buying of green beans is quite different, however, and is one of the most interesting features of the canning season in Spring-

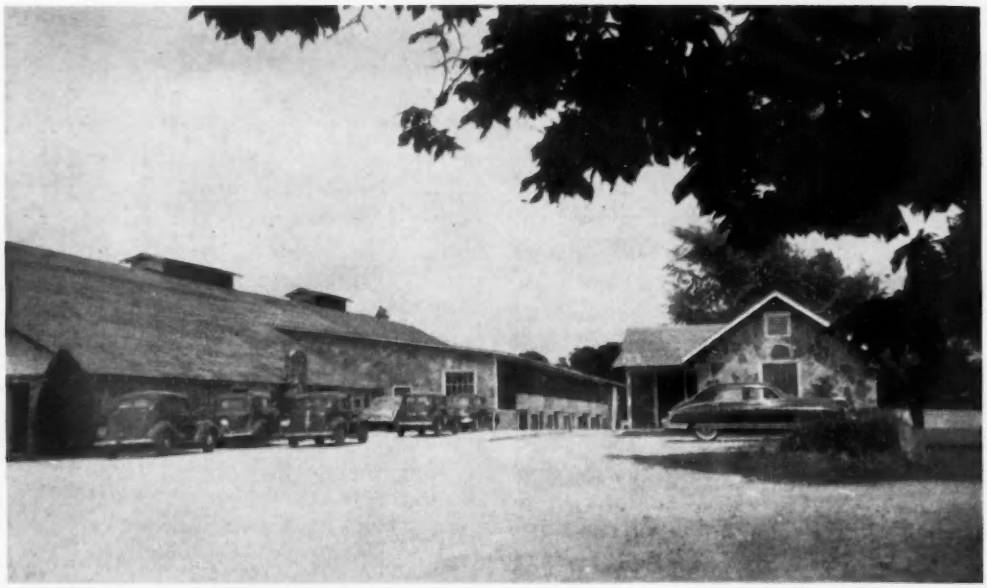

FIG. 4. One of the two locally-owned canneries in Springdale, Arkansas.

FIG. 5. Winery in Springdale.

dale. Not far from the main business district is the wholesale grocery and railroad district. Almost every hour of the day in the green bean seasons there will be at least one truck-load of beans halted in the middle of the street in this district, while canners or wholesale grocers first examine and then bid on the load at auction. Springdale is the largest green bean market in Arkansas.

The canned products from Springdale move to markets all over the United States, again by truck and to some extent by rail. One of the local canneries operates a truck line of its own, the other does not. For the majority of the products, particularly those which are destined for distant markets, transportation is arranged by the buyers, some of whom have their own fleets of vans. Buyers include large and small wholesale houses, and several large chain grocery stores. While some cans go out bearing the personal label of the Springdale cannery, most of them do not. The pack is marketed under a large number of different distributive labels used by the big buyers.

CONCLUSIONS

In 1940 for Washington County as a whole, the canning of foods and kindred products ranked sixth in occupational importance from the standpoint of numbers of persons employed. The 1950 census may show some gain in position, as the decade preceding 1950 was an active one in the canning business. One plant owner in Springdale estimates that since 1940 that particular cannery has enlarged its capacity seven or eight times.

This development of an industry which may be considered typical of northwestern Arkansas is of particular interest because it reflects the changing economic picture in this part of the state in the past 10 to 15 years. The rural and small-urban economy has developed amazingly in that time. The business districts of the towns are spreading, the highway fairly hums with traffic, and anyone who knew the rather somnolent region in 1935 would scarcely recognize it now. No attempt is made here to credit the canning business alone with this progress. However, there is no doubt that the canneries play a leading role in the economy, and perform a most valuable function for the farm areas of this region and of other districts outside of northwestern Arkansas.

Factors which help to account for the importance of the canning business may be summarized as being (1) the suitability of this area for fruit and vegetable production, (2) the relative ease whereby fresh products can be moved in and canned products can be moved out, (3) the general change in attitude towards land use in this region which is reflected in greater interest in farm specialization and in the establishment and development of small to moderate-sized industrial plants, and (4) the advantages accruing to the area from its early start in the canning industry, as it is convenient to can additional products in an established canning and distributing center.

ACKNOWLEDGMENTS

The author wishes to express her thanks for the information obtained through interviews with a number of individuals, notably Mr. F. J. Spurgin of Fayetteville, Secretary of the Ozark Canners Association, and Mr. W. A. Cain of Springdale, Secretary-Treasurer of the Cain Canning Company of Springdale.

AHURIRI LAGOON, NEW ZEALAND

A STUDY OF LANDSCAPE CHANGE AND RECLAMATION

Bryan H. Farrell

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THE Ahuriri Lagoon Development (also referred to as Ahuriri Lagoon Farm or Lagoon Farm), located three miles west of the city of Napier on the east coast of the North Island (Fig. 1), presents to the student of geography a study of particular interest which in many respects has no parallel. In less than 20 years a coastal lagoon has been uplifted during an earthquake, the surface drained by man, and the land gradually clothed in a vegetative cover ranging from the first salt-tolerating plant associations to established pastures of English grasses and clovers. Advanced technology and judicious utilization of the habitat have led to transformation of the landscape from apparent waste to productive farmland.

It is intended to consider the major geographic elements in the evolution of the Ahuriri Lagoon Farm, a portion of land, which, prior to the Hawkes Bay earthquake of 1931, formed part of the actual Ahuriri Lagoon. The land, drained and relatively free from water, is at present under the jurisdiction of the New Zealand Government Land and Survey Department for farming purposes. In tracing the development of this specific area consideration must be given to the formation of the ancient Ahuriri Lagoon and the very important Heretaunga Plain (Fig. 2).

Major Surface Features

The present land surface between Hawke Bay and the interior comprises four major components. Farthest west is the hardrock mountain axis of the North Island (Fig. 3). Between this highland and the coastal zone lies a belt of deeply dissected weak-rock hill country, while to the east of this zone is the gently sloping, triangular, Heretaunga Plain. The fourth component is an imposing gravel barrier beach lying seaward of the plain.

The highly distorted hardrock highland is composed of resistant Mesozoic sediments much of which is loosely termed "greywacke." In this highland rise the major rivers of the Hawkes Bay Province which have been responsible for the development of the Heretaunga Plain.

The thick Tertiary hill-country beds are composed of sandstones, limestones, conglomerates, and marls. Surface configuration, adjusted to the general northeast-southwest strike of weak rock, has commonly taken the form of asymmetrical ridges. The soft-rock surface is dissected by the systems of the major eastward flowing streams. These are, from north to south, the Tutaekuri, the Ngaruroro, and the Tukituki Rivers. These streams are actively stripping the

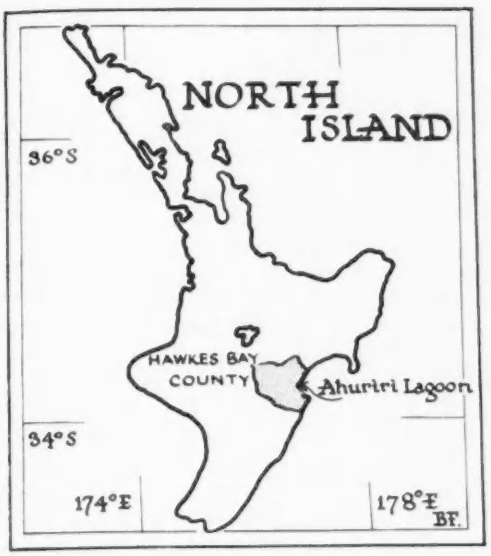

FIG. 1. North Island, New Zealand, showing location of the Ahuriri Lagoon Development.

less resistant beds and transporting the resultant detritus onto the plain.

The triangular Heretaunga Plain covers 85,000 acres including the Ahuriri Lagoon Development Block. This level delta plain, crossed by the three rivers and underlain by a considerable depth of sediment, is bounded in the north, west, and south by low hills, and in the east by Hawke Bay.

The imposing barrier beach, composed of hard, arenaceous gravel, extends a distance of approximately 20 miles along the seaward front of the plain. With a steep face to the sea and a gentle dipslope on the landward side, this ridge of unconsolidated material stands above the general level of the bordering plain.

Present surface forms probably developed in the following manner. In the Pliocene or early Pleistocene epoch large earth blocks were uplifted on the inner margin of the present Heretaunga Plain.[1] To the east of this uplifted area gradual subsidence took place together with submergence beneath the adjacent sea.

Rivers heavily laden with alluvium eroded from the uplands discharged into placid waters of the newly formed bay and in time fan-like deltas grew seaward. Of the present rivers crossing the delta plain the Nagruroro has played the leading role in lowland development.

As deltas advanced, a bar, which was eventually to enclose the large original Ahuriri Lagoon, was being built northward across the mouth of the bay until contact was made with isolated Scinde Island and later with the other side of the bay. In this manner a remnant offshore block was tied to the mainland on two sides. As deposition continued behind the gravel barrier and the deltas increased in size the lagoon slowly diminished in area.

MODERN AHURIRI LAGOON—BEFORE 1931

In 1930 the lagoon, a vestigium of the ancient water body, occupying a small area in the north of the lowland, was landlocked except for a narrow channel at Port Ahuriri which allowed entrance of tidal water through the barrier beach (Figs. 4 and 5). The depth of water within the lagoon was becoming progressively shallower with increased deposition from the western hill-country streams and from the Tutaekuri River. Deposition had taken place so effectively that of the 15 square miles of surface one-third was dry land at low tide. The small islands dotting the surface at high tide were merely banks of gravel and only two amounted to several acres in extent. The deeply indented western shoreline exhibited characteristics of a submerged coastline. Prominent headlands had been trimmed to well defined cliffs by the action of ocean waves in pre-lagoon times.

[1] G. Jobberns: "New Zealand Landscape. Hawkes Bay: Outstanding Appeal of Heretaunga Plain," *New Zealand Motor World*, January 9, 1948, pp. 10–11.

EARLY HUMAN USE

Te Whanganui-O-Rotu, as the lagoon was known to the Maori, was most significant to native life. Fish was a staple of the Maori diet and this enclosed water provided an ample supply.

Although native population in the vicinity was not large, most settlements were located close to the lagoon often in a strategic position in the nearby low hills or on the larger islands. Because of swampland on the plain, the beach became a main artery of early communication while the lagoon provided both food and the medium for inter-village canoe transportation.

European settlement began in the

FIG. 2. The Heretaunga Plain with the three major rivers responsible for lowland deposition. River channels are bordered by levees for flood protection. The Lagoon Farm is located on the plain to the northeast of Napier.

1840's and in the next decade a small port developed at the lagoon outlet but at no time were large ships able to berth within the lagoon because of shallow water.

By 1930 the small coastal port still functioned while the major portion of the lagoon was used only for recreational purposes together with some commercial fishing. Fishing and shellfish gathering still continued but now as a recreational activity rather than a nutritional necessity. Because of the resort nature of the lagoon a colony of inward-facing "seaside" dwellings had been constructed along the gravel beach. Little did owners imagine that in February, 1931, these houses would face dismal mud flats, stagnant pools, and evil-smelling stranded mollusks and crustaceans.

TRANSFORMATION OF LANDSCAPE

On February 3, 1931, much of New Zealand was rocked by an earthquake of considerable force. This disturbance of intensity X (ten) on the Rossi-Forrel scale resulted in a national calamity. Two hundred and fifty-six lives were lost mostly on the severely affected Heretaunga Plain and nearby area. The resultant transformation of the Ahuriri Lagoon was almost inconceivable. The lagoon floor was elevated about five feet (six feet at the outer margin and three and one-half feet at inner border[2]). Such a drastic change in surface elevation was sufficient to expel much of the surface water and uncover over 3000 acres of land.

The stench of dead fish and stale water was most obnoxious while putrefying and decomposed organic matter presented a serious sanitation problem. With a view to future settlement, and the removal of any epidemic danger that might arise, the Napier Harbour Board, the owners of the new land, offered the entire area to the Government for the purpose of bringing the land "into profitable occupation." Three years after the earthquake the Public Works De-

[2] P. Marshall: "Effect of the Earthquake on the Coastline Near Napier," *New Zealand Journal of Science and Technology*, Vol. 15, 1933, pp. 77–99.

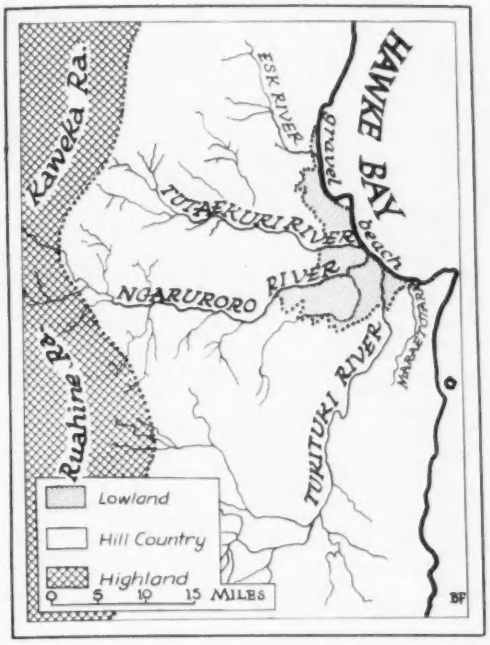

FIG. 3. The four major surface features are shown above: the highland, the hill country, the plain, and the gravel beach.

partment commenced reclamation operations.

The initial work consisted of constructing levee-protected contour channels (Figs. 7 and 11) at the foot of the bordering hills to receive run-off from the outside hill country. The surplus water was directed by means of an 800-feet wide channel into Port Ahuriri Harbour and the open sea.

The developmental area covering 7753 acres was divided for drainage purposes into a northern sector of 5189 acres and a southern portion of 616 acres. These divisions lay north and south of the outflow. A rectilinear network of dewatering channels (Fig. 6) was constructed over much of the area. Surplus water was drained towards the center and then pumped several feet into the main gravity outflow. Furthermore, the course of the Tutaekuri River was straightened in order to bypass the former lagoon. As part of the development roads, stockyards, fences and several buildings were constructed, some shelter trees planted, artesian water reticulated over much of the area, and dozens of stock water troughs installed. Above all pumping removed the surface water from 5805 acres.

PHYSICAL BASES OF FARMING

The climate of the area may be described as being both mild and humid, a direct result of the two major controls: a maritime location and the prevailing westerly winds. Summer temperatures are never hot though in most years temperatures of 80° F. may be expected occasionally from November to March. The warmest month, January, has a mean temperature of 65.5° F. with the highest temperatures usually associated with northwest foehn winds. Winter

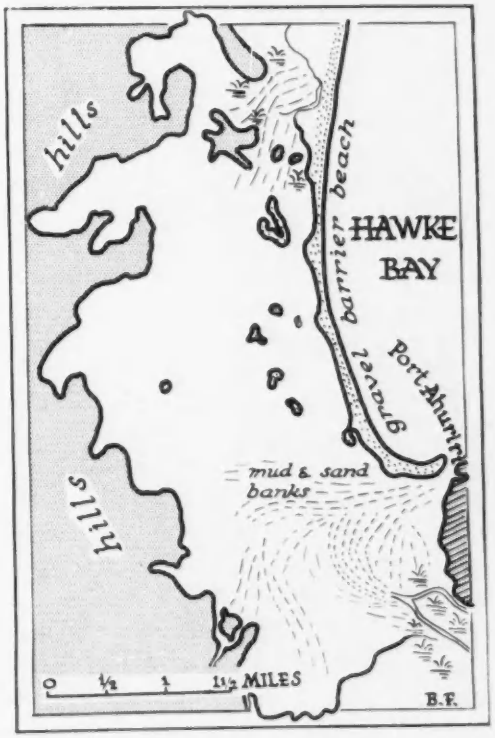

FIG. 4. The Ahuriri Lagoon showing the small islands, the entrance at Port Ahuriri, and the Tutaekuri River entering at the southeast corner.

FIG. 5 (left). The gravel barrier beach which in the north protects the Lagoon Farm from being flooded by the sea.

FIG. 6 (right). The Main Dewatering Drain North. Surplus waters are pumped from here into the outflow.

temperatures are particularly mild due to the marine influence of Hawke Bay. July, the coolest month, averages 46.8° F. Moderate temperatures allow a long period of pasture growth and obviate the necessity for the winter housing of livestock. Hours of possible sunshine are high (2416) and frosts are infrequent.

The area under discussion, protected by both highlands and hill-country, receives less rainfall than places at a similar latitude on the west coast. While prevalent anticyclones travel eastward, fronts normally develop in the trough or low between two moving highs. When deep lows develop and their centers pass within 400 miles of Napier on the north, Hawkes Bay County (Fig. 1) usually is affected by heavy frontal rains borne by onshore winds.[3] Rainfall in the area is by no means representative of Cfb climate in that it is characterized by high intensity and great percentage variability. The mean annual rainfall is 31.48 inches with the highest monthly averages in the late autumn and winter months of May, June, and July. A drier season, which is of considerable consequence in relation to farm practice, prevails from early spring through the summer months.

Soils of the reclaimed lands are potentially rich and may support highly productive farms of the future. Available phosphates are two and one-half to three times higher than in some fertile New Zealand soils while the potash content is four to ten times higher than in most farm soils.[4] Also available is an ample supply of lime, magnesia, and other mineral plant foods. In 1932 the soil salinity varied from 0.5–2 per cent sodium chloride. In following years percentages fluctuated widely according to the amount of rainfall, the intensity

[3] E. Kidson: *Climatic Notes. New Zealand Districts*, Meteorological Office Note No. 17, 1937.

of summer heat, and the texture of associated soils.

Soil texture ranges between two extremes of sand and clay. Fortunately over most of the area loamy types of soils are found and together with flat featureless terrain cultivation may take place with relative ease. There is a close correlation between chemical characteristics and soil textures. Sandy areas are leached more rapidly than the average soil with the result that in the south the salt content has been greatly reduced allowing better utilization of the land.

In order to hasten leaching 352 miles of small lateral desalting drains were constructed over most of the area and by this means vadose and run-off water with salt in solution is carried away to the main drains (Fig. 13). This process is most active during the rains of winter and early spring and least active in the summer when dry hot conditions may draw salt to the surface to lie as a white crystalline deposit (Fig. 8) ruining crops and causing pasture retrogression. In certain low lying areas, the upper soil gains its salt in this manner from a never ending supply of "sea-fed" ground water. Gradually large areas are diminishing in salt content and in many places apparently useless ground has become useful farmland.

The dominant factor regulating the establishment of different plant species

FIG. 7 (upper left). The contour channel which conducts hill-country run-off directly into the Port Ahuriri Harbour.

FIG. 8 (upper right). Exposed surface salt has here produced bald white patches in a field of barley.

FIG. 9 (lower left). Harvesting barley in January with an American manufactured combine.

FIG. 10 (lower right). A draft of fat wethers selected by the buyer and awaiting transportation to the freezing works.

is the extent and rate of salt leaching in particular localities. *Salicornia australis* was the first plant to appear indicating a fairly high salt content of 1.52 per cent sodium chloride.[4] As salinity declined new species came in. W. R. B. Oliver gives a general picture of dominant species in declining order of salt tolerance:

1. *Salicornia australis* (most salt tolerant)
2. *Cotula coronopifolia* (dominates soils with less salt content)
3. *Melilotus alba* and *Sonchus oleraceus* (occupying soils with the lowest salt content)[5]

Although scientific tests are used, the presence of white sweet clover (*Melilotus alba*) or tall fescue (*Festuca arundinacea*) gives a rough indication that the land is capable of carrying pastures of English grasses.

LAND USE ON THE LAGOON FARM

In April, 1934, the Land Development Branch of the New Zealand Government Land and Survey Department commenced farming operations when 1000 acres of former lagoon land were swamp plowed, disked, replowed, and finally planted to 75 acres of spring crops, and 925 acres of surface sown white clover (*Trifolium repens*).

In 1936, on a 60-acre plot, experimental crops of wheat, oats, barley, mangolds, rape, kale, millet, maize, potatoes, kumaras (sweet potato), peas, pumpkins, soft turnips, silver beet, carrots, and other root crops were grown and the results carefully noted. Cropping was merely experimental as it was seen that intensive cropping would not be conducive to the building of much needed fertility.

By the following year desalting had advanced enough for 1100 acres to have been planted in permanent, temporary, and surface sown pasture. At the same time the farm was carrying 200 cattle and 3300 sheep.[6] Three years later it was found that several species in the natural pasture were palatable to livestock and successful experiments were carried out in harvesting and sowing land to these useful plants.

TABLE I

LAND USE IN ACRES, JANUARY 1, 1951*

Natural pasture	1,387
Permanent pasture and other sown pasture	2,923
Total pasture	4,310
Lucerne (alfalfa)	70
Barley	260
Pumpkins	30
Mangolds	20
Total crop	280
Crops and pasture	8,590
Other uses (roads, ditches, water features, buildings, dispositions)	3,163
Total area	7,753

*Department of Lands and Survey, Napier.

TABLE II

LIVESTOCK, JUNE 30, 1950*

Ewes	6,097	Total cattle	653
Wethers	4,907	Total horses	3
Hoggets	11		
Rams	183		
Total sheep	11,198		

*Department of Lands and Survey, Napier.

Since 1940 farming activity has conformed to a pattern of maintenance and establishment of pastures, handling and feeding of livestock, and the planting, cultivation, and harvesting of supplementary crops. Since the first cultivation the area in planted pasture has increased to about 2900 acres (Table I). The stocking capacity has steadily improved and stock figures for June, 1950, showed a total of over 11,000 sheep on the farm (Table II). Income from live-

[4] B. C. Aston: "The Napier-Ahuriri Lagoon Lands," *New Zealand Journal of Agriculture*, Vol. 46, 1933, pp. 69–77, 260–266.

[5] W. R. B. Oliver: "The New Vegetation of the Seafloor Raised by the Hawkes Bay Earthquake of 1931," *Records of the Dominion Museum*, Vol. 1, 1942, pp. 1–19.

[6] *Annual Report of the Chairman to the Napier Harbour Board*, 1937.

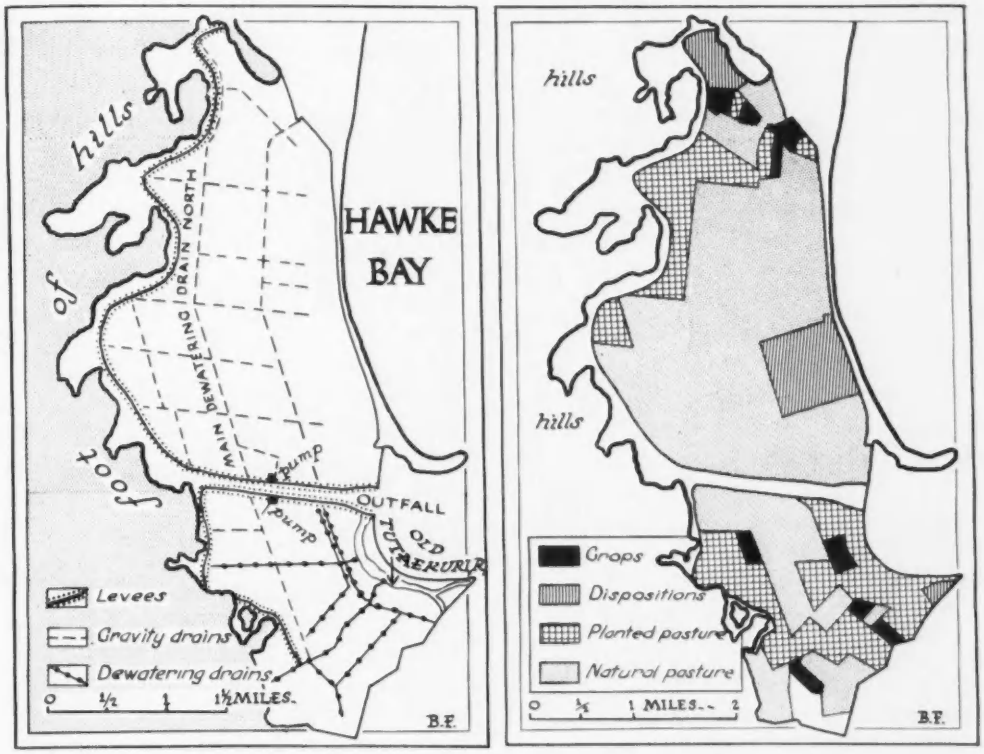

FIG. 11 (left). Reclamation Drainage. Water from near-by hills is directed into the contour channel at the foot of the hills. Surplus water on the farm drains towards the central pumping stations where it is lifted into the gravity outfall.

FIG. 12 (right). Land use on the Lagoon Farm, January, 1948. Little land is utilized for cropping whereas the larger areas of pasture show that grassland farming is dominant.

stock amounted to over $171,800 during the preceding year.[7]

Pastoral farming is the dominant activity, a fact clearly shown by the paucity of cropland. The main crops are grass seed for sale and for re-seeding farm pastures; mangolds, cattle pumpkins, and hay for supplementary winter feed; Japanese millet for "topping-off" late lambs; and barley as a cash crop (Fig. 9). Approximately 100 acres of former farmland have recently been disposed of to war veterans for the purpose of part-time farming. Ten small farms now produce satisfactory crops of garden vegetables and small fruits.

Livestock farming is mainly confined to the production of fat sheep and lambs for sale (Fig. 10). Romney ewes are not bred on the property but are bought-in from East Coast hill country stations. Well bred Southdown rams are imported from the Wellington Province to the south. The black face lamb, the progeny of a Southdown ram put to a Romney ewe, has proved most successful. Most fat lambs and surplus livestock are sold during the summer to a freezing works near Hastings.

Each year some cattle are wintered on the property in order to keep rough pasture in check though it is the policy to retain as small a number of cattle as possible during the months when grass growth is least.

Main agricultural problems include

[7] Personal Communication with Mr. Nelson Clay, Commissioner of Crown Lands, Napier.

water seepage from the sea, soil salinity with its concomitant effects on crops and pastures, soils deficient in organic material and copper, a limited water supply, lack of shelter for livestock, and an excess of rabbits. Many of the problems are of a temporary nature and can be expected when bringing land such as this into useful occupation.

CONTRASTING LANDSCAPES

The Lagoon Farm although not an extensive area appears large because it is low, bare, and monotonously flat. Its dull green landscape is dominated by straight and parallel lines. The coloring is unusual and impressive. Gray-green natural pasture, dotted with countless white-backed sheep, clothes much of the area, and somber shades are relieved only by the lighter green of exotic pasture, the pale yellow of ripening crops, the brown of tilled land, the white ribbons of roads, and the occasional glint of sunlight on a water-filled channel. Closer scrutiny will show bare patches devoid of vegetation and veneered with a white saline efflorescence.

Upon this level surface vast geometrical "dissection" has taken place. Straight fences mark off large fields. Natural streams have been replaced by culturally induced drainage forms represented by a rectilinear network of parallel drains and ditches, protective raised levees, the wide muddy outflow, and two small green pump houses. Paralleling the dewatering drains a reticulated road pattern is set upon this treeless tract—a tract almost devoid of human habitation yet well in view of near-by Napier, a city of 20,000 people.

Noise and movement is at a minimum. Above the bleat of sheep may be heard the roar of a tractor hauling a huge swamp plow through virgin soil in preparation for new pasture, or the farm manager's small utility truck, the lonely user of one of the many private roads. Slowly a cloud of dust rises above the stock yards, where yapping dogs and shepherds with bicycles—not the traditional horse—move sheep.

Morphologically the farm and the Heretaunga Plain are as one. Each originated from the deposition of terrestial material in shallow water. Physiognomically both are flat lowland areas, the one merging with the other. Climatically the two are very similar. Agriculturally each can support to some extent the highest producing quality of exotic pasture and both are able to rear healthy livestock. Yet a sharp division separates the two and in few other ways can the abutting landscapes be considered alike.

The tree-studded, intensively farmed Heretaunga Plain forms the agricultural heart of Hawkes Bay County. Its small farms, willow-flanked rivers, belts of poplars, pines (*Pinus radiata*), and macrocarpa (*Cupressus macrocarpa*) are in marked contrast to the large fields and sparcely populated bareness of the Ahuriri Lagoon Farm. Lamb fattening, truck cropping, fruit production, and dairying are the farming activities of the plain. Sheep raising is the dominant occupation on the farm.

On the plains one senses activity as produce moves swiftly along highways linking the many small settlements and leading to the larger towns; the farm roads remain silent.

Though contrasts are strong, it should be remembered that the plain, now a highly productive core, emerged from swampland. The farm had a somewhat parallel beginning. In the years to come differences will become less obvious and comparisons stronger until in time the two landscapes will exhibit a greater degree of likeness.

FIG. 13. A representative farm landscape, showing a network of desalting drains, farm roads and a contour channel on the extreme right. Light colored cliffed headlands are shown in the background, while in the foreground, hundreds of sheep and their irregular tracks may be seen. (Airview by V. C. Browne.)

On the weak-rock hill-country to the west sheep are grazed on poor pastures of *Danthonia pilosa* and brown top (*Agrostis tenuis*). Sheep numbers are small compared with the large flocks carried on the lagoon area and farming on the hills is extensive while that on the lowland is intensive. Whereas the farm rears fat stock, the hill country concentrates on store sheep, and whereas areas of pasture are being increased on the lowland, grasslands of the hills are deteriorating from over-grazing and soil removal. In few ways do these two landscapes resemble each other.

CONCLUSION

This paper has considered the changing landscape of the Ahuriri Lagoon Farm and an attempt has been made to show the main steps in the process of transformation from coastal lagoon to productive land. There seems little doubt that parts of the area will form excellent farm land in the future. When this will be depends on many elements among which soil salinity, technical knowledge, settlement programs, and land ownership appear to be a major significance.

The land has been brought into the initial stages of production by a government able to draw on advanced scientific knowledge and with sufficient capital to finance major developmental operations and to absorb losses in case of failure.

Today some people are advocating

the subdivision of land for immediate settlement. The advantage of small holdings, hard work, and individual attention may be apparent in sweetening the soil more quickly as well as creating greater production. Serious results may ensue, however, from indiscriminate subdivision and hurried settlement.

At the present time there appears to be room for intensive research, study, observation, and experiment in attempting to determine the desirability of the land for settlement. New types of grasses most suitable for different parts of the farm and the effects of planting more land to soil enriching legumes may provide means for more intensive utilization of the land.

It is interesting to note that in a country where fertile lowland is at a premium a not insignificant area has been brought into useful production and is being developed for increased human use while nearby hill country deteriorates through the ravages of accelerated erosion.

THE FLOUNDER INDUSTRY OF THE SOVIET FAR EAST

V. Katkoff

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PRIOR to 1930 commercial fishing for flounders in the Soviet Far East was restricted to Peter the Great Bay and even there was on a limited scale. A fishing fleet of about 300 kavasaki (the kavasaki is a Japanese fishing vessel adapted by the Russians for fishing in the Far Eastern waters only), whaleboats, wherries, drifters, and a few seiners used to concentrate in the area using Danish nets or similar equipment reaching to depths of 50 to 70 meters. The abundance of flounders in Peter the Great Bay stimulated an expansion of the industry, and by 1930 trawlers appeared on the scene reaching for flounders to a depth of 200 to 250 meters. With increased fishing fleets, fishing waters expanded to Kamchatka as well as to other regions of the Maritime waters. Thus, by 1930 many Far Eastern regions caught flounders, but it was not until about 1942 that the industry became important.

Landing of Flounders: 1930–1945

There are several reasons for this expansion. Prior to World War II, sardines were the major sea crop of the Maritime fisheries, but just before the War sardines became scarce in the waters of the Maritime region, forcing the local fisheries to intensify their catch of flounders. With the beginning of the War the demand for fish products sharply increased, thus compelling the fisheries to increase even more their output of flounders. These two major factors made the Maritime as well as other fisheries change their annual plans and practices. However, it was not a revolutionary change because flounders appear in the Maritime waters ahead of the sardines; and canneries processing salmon are busy for two months only. Thus, in the shift to flounders there was no particular strain on the existing fishing facilities.

According to Table I, waters of Peter the Great Bay have supplied most of the flounders. In 1931 to 1933 about 40 per cent of the total catch of this fish was from the waters of the Okhotsk and the Bering seas in Kamchatka. This increase in Kamchatka waters was due to the additional number of trawlers allocated to this region. But in 1933 these trawlers were shifted from Kamchatka to other Soviet waters and the flounder catch was reduced. The shift made the whole Far Eastern fishing industry dependent largely on smaller fishing boats which were unable to reach the deep waters. The output of the industry decreased as can be seen in Tables I and II.

Table II shows that after 1936 there was an expansion in various bights of Peter the Great Bay which was the main source of flounders in the Maritime region. Then in 1938 the output of flounders declined, but it increased in 1940 and by 1942 the total landing of flounders was almost four times

greater than in 1935. It is also interesting to note that since 1935 fishing for flounders was moving northward along the Maritime shores.

TABLE I

TOTAL LANDING OF FLOUNDERS IN THE FAR EAST IN METRIC TONS

(After P. A. Moiseeff, "Promyslovye Kambaly Dalnego Vostoka," Moscow, 1946, p. 6)

Year	*Total*	*Peter the Great Bay*	*Upper maritime waters*	*Tatar Strait*	*Kamchatka*
1930	1,400	1,000	.....	.....	400
1931	7,700	5,500	.....	.....	2,200
1932	12,700	8,000	.....	.....	4,700
1933	10,400	7,700	.....	.....	2,700
1934	6,400	6,100	300	.....	.....
1935	4,000	3,500	500	.....	.....
1936	6,700	5,000	1,700	.....	.....
1937	5,700	5,000	700	.....	.....
1938	3,200	3,100	100	.....	.....
1939	2,300	2,200	100	.....	.....
1940	3,500	2,700	300	.....	500
1941	5,400	4,100	600	.....	700
1942	15,500	10,200	3,700	.....	1,600
1943	20,200	9,800	3,000	3,400	4,000
1944	22,200	4,200	.....	7,900	10,100
1945	24,500	.....	.....	.....	.....

AVERAGE EFFICIENCY OF SEINERS IN 1936

The expansion of fishing activities into other regions was made possible through a limited replacement of sail and row boats by seiners in 1936. The Soviet press states that prior to World War II a 60 hp. seiner caught an average of 92 metric tons of flounders, while a kavasaki caught an average of 12 metric tons. An analysis of efficiency of seiners showed that the larger the boat the greater the catch.

From Table III it is obvious that the larger seiners are more productive. This is because they reach deeper waters where the fish is more abundant. However, in 1936 the Soviet government had only a limited number of seiners and other motor boats adaptable for fishing in deep waters, and large amounts of flounders were caught in the shallow waters where operation of large motor fishing boats was impracticable.

LANDING OF FLOUNDERS DURING THE WORLD WAR II

World War II stimulated expansion of all Far Eastern fisheries. In 1943 the Tatar Strait began to land flounders too. In 1944 there was a drastic change when the catch of Peter the Great Bay was reduced from 10,200 metric tons (in 1942) to 4200 metric tons, while the northern waters of the Tatar Strait and Kamchatka produced 18,000 metric tons. How much of this shift is production can be attributed to war conditions and how much to the decreased population of flounder in the waters of Peter the Great Bay is difficult to estimate. Perhaps military considerations played the greater role. However, the war with Japan did not start until August, 1945, and ended shortly after. The Soviet press does not indicate that the Japanese damaged the Soviet fishing fleet at all, but no doubt the Soviet government moved it out of Vladivostok, fearing destruction by the Japanese. In 1945 the total output of flounder was 24,500 metric tons. Between 1941 and 1945 the Maritime region as a whole caught over 385,000 metric tons of all fish.[1] During the same period this region produced 39,800 metric tons of flounder or approximately 10.4 per cent of the total Maritime landing against approximately 3.0 per cent in 1941.[2] This suggests that during the War there was a considerable stress on landing of flounders by utilizing shallow waters and by using small fishing vessels.

MIGRATION HABITS OF FLOUNDERS IN PETER THE GREAT BAY

Flounders are found throughout the whole Soviet Far East from Korea to

[1] *Pravda*, October 15, 1945.

[2] "Gosudarstvennyi Plan Rasvitia Narodnago Khozaistva S.S.S.R. na 1941 God," Moscow, 1941, p. 724. See, also, P. A. Moiseeff, "Promyslovye Kambaly Dalnego Vostoka," Moscow, 1946, p. 6.

TABLE II

LANDING OF FLOUNDERS IN THE MARITIME IN METRIC TONS

(After P. A. Moiseeff, p. 9)

Bights	*1935*	*1936*	*1937*	*1938*	*1939*	*1940*	*1941*	*1942*
Ussuri	2,800	2,826	2,497	1,991	1,123	1,386	1,411	2,786
Amur	.....	.....	84	79	117	180	307	839
Posiet	700	106	.....	78	28	16	317	1,884
Strelok, Vostok, and Amerika		1,192	1,730	856	912	1,174	2,118	3,896
Preobrozhensk	.....	32	291	103	3	.....	117	1,785
Northern Maritime	.....	.....	.....	.....	.....	259	383	1,905
Total	3,500	4,156	4,602	3,107	2,183	3,015	4,653	13,095

the Chukhotsk region of Kamchatka which lies a few miles from Alaska and St. Lawrence Island, but the concentration points of this fish are in Peter the Great Bay, the northern region of the Tatar Strait, and along the shores of western Kamchatka. Unlike salmon and herring, flounders do not migrate great distances and in general remain the whole span of their lives, which runs up to 15 years, in the region where they were born.

The distance covered by flounders varies from region to region. In the middle and in the northern parts of western Kamchatka flounders migrate more than 100 kilometers from the shores before they reach desirable winter waters located at the southern end of Kamchatka. In Peter the Great Bay and in the Maritime regions, flounders migrate 30–40 kilometers to their winter bed.

The main winter concentration of flounders in Peter the Great Bay is located at the so-called "Bed of Askold Island," which lies south of Askold Island as shown on the map (Fig. 1). By March this bed covers 90–110 square miles and reaches a depth of 200–250 meters, which indicates that fishing in this region can be done only with larger fishing boats.

At the end of March and at the beginning of April the winter "hibernation" of flounders is disturbed and schools begin to move in a fan-like pattern toward the shallow waters of Peter the Great Bay. The greatest percentage of moving fish is headed toward the northwestern region of the Bay, i.e., to Askold Island, Russian Island, Vostok and Amerika Bights, to Povorotnyi and Zelenyi Capes, and even to the Valentina Bight. This migration is a wave-like and orderly movement of masses of fish, each wave composed of different species, ages, and sex, and each moving independently from the others.

TABLE III

AVERAGE CATCH OF FLOUNDERS PER SEINER IN METRIC TONS, APRIL 25–JUNE 5, 1936

(After P. A. Moiseeff, p. 9)

H. P.	*Number of seiners*	*Average catch*
25	3	45.6
20	4	30.6
12	3	18.1

The leading species is *Limanda yokohamae* or the Japanese flounder which comes from a depth of 170–250 meters to a depth of 30–50 meters in 10 to 30 days, traveling on an average of one to two miles per day. To the middle of May this single species represents 85 per cent of the total catch by the smaller fishing boats.

After the masses of Japanese flounder reach the shallow waters, three other species (*Limanda herzensteini*, *Limanda*

proboscidea punctatissima, and *Cleisthenes herzensteini*) begin to appear there. At the beginning of May at a depth of 25 to 35 meters the most valuable species, *Limanda aspera*, appears, followed by *Hippoglossoides elassodon dubius* and *Clyptocephalus stelleri*.

According to Table IV three species (*Limanda herzensteini*, *Cleisthenes herzensteini*, and *Limanda aspera*) represent from 65 to 85 per cent of the total catch in Peter the Great Bay. The commercial catching of flounders with small fishing boats begins in the first half of April and terminates at the end of November, a total of 220–230 days per season, which suggests that this fish must be available fresh on the market during the greater part of the year.

With the beginning of autumn (September-October) flounders gradually slide down to deeper waters; however, the greatest bulk of them is still at a depth of 30–60 meters. By November this retreat is intensified and flounders reach waters of 70–90 meters in depth, and in December they may be found at 80–100 meters. By March they reach a depth of 200–250 meters, where change in winter temperature is negligible. During the whole winter period between December and March flounders concentrate in one region where deep-sea fishing is possible. Out of about 25 species found in the waters of Peter the Great Bay only three species, *Liopsetta pinnifasciata*, *Liopsetta obscura*, and *Liopsetta glacialis*, remain within the shallow waters in the winter. The commercial value of these species is insignificant, however.

Fishing with snurrevoode (Danish nets) and similar methods in the shallow waters naturally brings other species of fish, too. In Peter the Great Bay along with flounders are caught goby, trepang, cod, Kamchatka crabs, and various other species. In 1936 about 300 fishing boats during 40 days of fishing operation in this area caught 150 metric tons of goby and other fish, a bulk equal to 3 per cent of the total catch of flounders. In 1942 the fishing combine "Tafuin" operating in Vostok Bight caught 489 metric tons of goby or 20 per cent of its total landing.

The other concentration of flounders in Peter the Great Bay is found below

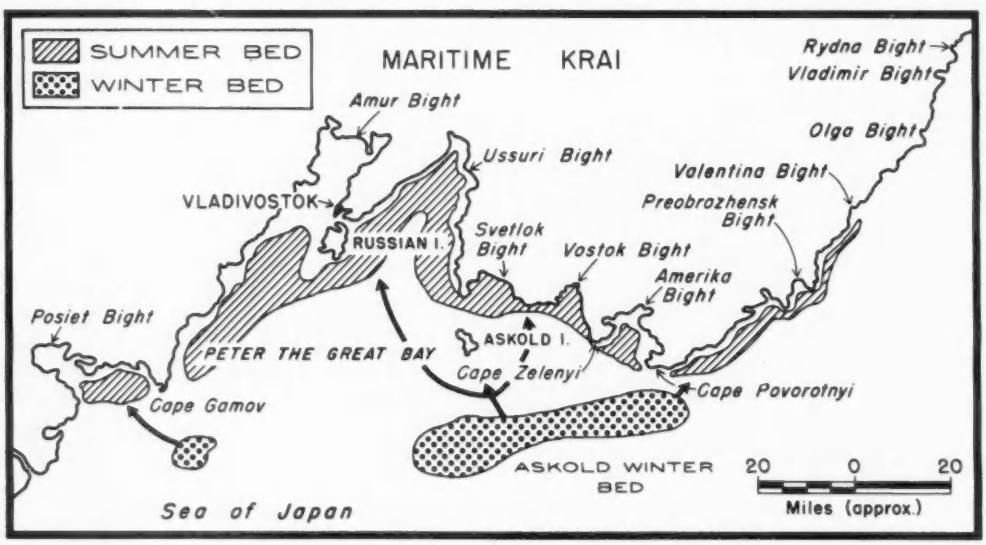


FIG. 1. Summer and winter concentrations of flounders in Peter the Great Bay.

TABLE IV

SPRING APPEARANCE OF FLOUNDERS IN PETER THE GREAT BAY

(After P. A. Moiseeff, p. 25)

Species	*Depth of 45–50 meters*	*Mass appearance*	*Percentage of total catch*
Limanda yokohamae	April 12–16	April 25–May 5	5–10
Limanda proboscidea punctatissima	April 20–25	May 1–10	5–10
Limanda herzensteini	April 20–25	May 1–10	10–15
Cleisthenes herzensteini	April 25–30	May 5–15	30–35
Limanda aspera	May 1–10	May 15–20	25–35
Others	May 1–10	.....	5–10

Cape Gamov and in Posiet Bight, near the Korean border. In 1935 this region caught 20 per cent of the total landing of flounders, but since that year the output of this region had declined and only with the beginning of the World War II its fisheries intensified their activities, producing about 13.6 per cent of the 1942 catch. There are many reasons for this drop in production, but the main reason lies in the fact that most of the fishing in this region has been done by Chinese and Korean fishermen who moved their fishing equipment and gear elsewhere instead of pooling it into the collective fishing enterprises which the Soviet government forced upon the Russian fishermen.

MIGRATION HABITS OF FLOUNDERS IN THE TATAR STRAIT

Prior to 1943 there was no fishing for flounders in the Tatar Strait (Fig. 2). In 1943, because of the disappearance of the sardines, the high demand for fish, and preparation for the war with Japan, the Maritime fisheries organized an expeditionary fishing fleet, consisting of numerous kavasaki and seiners, one factory-ship, and one refrigerator-ship, which began to operate in the Tatar Strait. Because of the newness of this venture the landing of flounders and other fish was not as good as was expected. In 1943 a single take with snurrevoode in this region was 1.9 metric tons whereas in 1944 it was 3.2 metric tons. The greatest difficulty, of course, was the wartime shortage of experienced fishermen to boost the needed output.

TABLE V

TOTAL CATCH OF FLOUNDERS IN THE TATAR STRAIT

(After P. A. Moiseeff, p. 40)

Year	*Number of seiners*	*Metric tons*
1943	17	3,400
1944	22	7,900
1945	36	4,300

In 1945 although the Tatar Strait fisheries had 64 per cent more seiners than in 1944 the total catch of flounders was 60 per cent less. The Soviet press explains this reduction in output by the lack of proper organization within the industry and the general confusion created by the war with Japan, which resulted in many seiners being idle or only partially utilized.

With the beginning of spring in the Tatar Strait, flounders leave their hibernal waters, which are located at the depth of about 200 meters approximately in the middle of the southern Tatar Strait between the Soviet Bight and Sakhalin Island. Leaving their winter bed, flounders migrate toward Sakhalin Island, especially to waters between Cape Rogatyi and Viakhta Bight (Fig. 2). The summer concentration of flounders is called the "Aleksandrovsk Flounder Bed."

This migration of flounders from deep-sea waters to shallow waters begins in April, and at the beginning of May large schools of flounders appear in waters of 40–50 meters in depth. The most important species which starts the migration is *Limanda aspera* with its young stock moving ahead of the matured fish. By the middle of May *Limanda aspera* reaches Viakhta Bight on the eastern shore of Sakhalin Island where the depth is 30–50 meters. *Pleuronectes quadrituberculatus* and *Hippoglossoides elassodon dubius*, which are large species, move in after *Limanda aspera*.

In June, flounders may be found at a depth of 15–40 meters, which of course facilitates landing them with the smaller fishing vessels. In August the main body of flounders moves to a depth of 60 meters (except that in the southern region of the Aleksandrovsk Bed the depth reaches 60–80 meters). The young stock, however, still can be found at 20–30 meters, while matured species are at 70–80 meters. In September, flounders begin to migrate back to their winter deep-sea bed, and in October the retreat is so accelerated that at the end of this month smaller fishing vessels can not reach them at all. In general, from May to October, small fishing vessels successfully fish for flounders. This represents between 170 and 180 fishing days, which makes these smaller fishing vessels an important part of the Soviet Far Eastern fishing fleet.

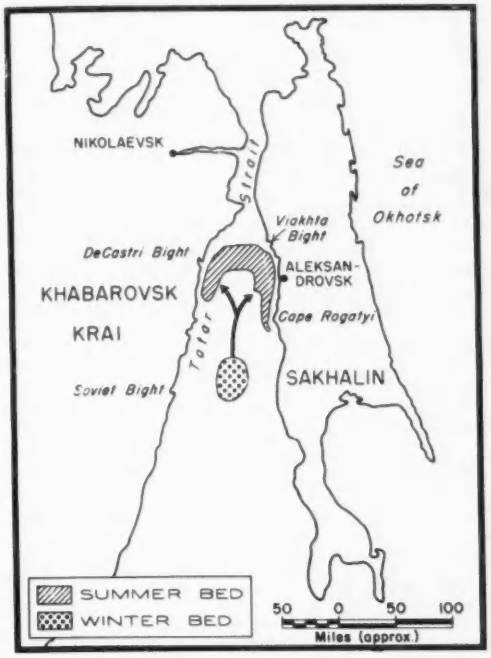
MIGRATION HABITS OF FLOUNDERS IN KAMCHATKA

As a whole, Kamchatka is the most productive fishing region of the Soviet Far East. A wide, shallow-watered plateau, extending along the Western Kamchatka from Cape Kambalnyi on the south to Cape Youzhnyi on the north provides excellent feeding and breeding waters for flounders. There are several winter and summer beds where flounders concentrate. The winter bed in the region of Ozernaia-Koshegochik of Western Kamchatka is at a depth of 100–170 meters. In the region of Kukhchik-Kimuchi flounders slide down to 180–250 meters and southeast of Cape Lopatka flounders live at a depth of 210–290 meters. The individual winter beds may be as far as 60 miles off the Kamchatka shore. Only one species, *Liopsetta glacialis*, may be found in the shallow waters in the winter.

There are five beds where flounders concentrate in the summer, but only three are well known: (1) the Southern Bed or so-called "Osernoff Bed," (2) the Central Bed, and (3) the Northern Bed or the "Khariusovsk Bed."

The Osernoff summer bed covers about 800 square miles. In this region about 80 per cent of the total catch consist of *Limanda aspera* with the other 20 per cent distributed among *Pleuronectes quadrituberculatus*, *Hippoglossoides elassodon dubius*, and *Limanda proboscidea proboscidea*. The summer Central Bed is about 100 miles long and 10–30 miles wide and covers an area of 2000 square miles, reaching a depth of 10–60 meters. The summer Northern or the Khariusovsk Bed covers about 1000 square miles and the highest concentration of flounders is at 60–65 meters. The other two summer beds the one between the Khariusovsk and Central beds and another near Petropavlovsk are the least known and detailed information about them is not available at the present.

Migration of flounders from their winter beds begins in early April. First *Limanda proboscidea proboscidea* moves toward the shallow waters of the Western Kamchatka followed by *Limanda aspera*, which is the most valuable species. In



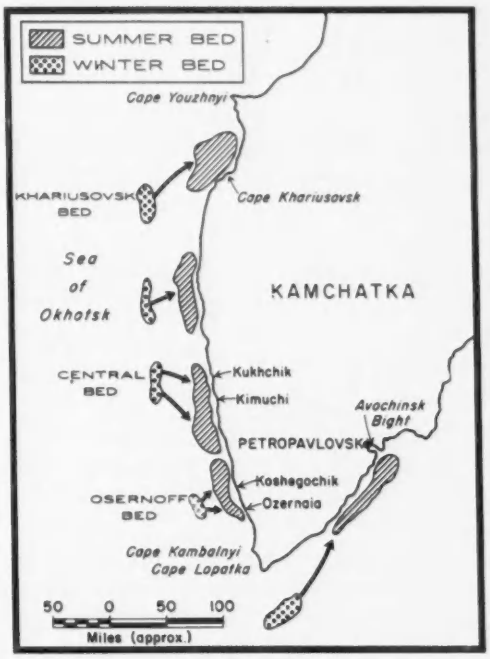


FIG. 2 (left). Summer and winter concentrations of flounders in Tatar Strait.
FIG. 3 (right). Summer and winter concentrations of flounders in the Sea of Okhotsk.

May, migration highly accelerated and by June almost all species of all ages have left their winter waters and moved to a shallow depth of less than 100 meters. Maximum summer concentration of *Limanda proboscidea proboscidea* is at about 15–30 meters and *Limanda aspera* 15–65 meters. *Pleuronectes quadrituberculatus* concentrate at a depth of 45–120 meters. *Hippoglossoides elassodon dubius* moves very slowly toward the shore and prefers a depth of 40–140 meters; the greatest yield of this species is obtained at the depth of 80–120 meters. Thus because of its preference for depth this species is not as important as the other species which live en masse in more shallow waters.

In September begins a gradual disappearance of flounders from the shores of Kamchatka, and by the end of that month *Pleuronectes quadrituberculatus* can be found at a depth of 100–140 meters (approximately 40–50 miles from the shores). About 20 per cent of the total catch of this species is at a depth of 70 meters. By the end of October, flounders are so deep in the water that small fishing vessels are unable economically to land the fish and by January migration to winter beds is completed.

POTENTIAL LANDING OF FLOUNDERS IN KAMCHATKA

Kamchatka has great potentiality in the development of flounder fishing. This region is rich in feed for the fish, the bottom of the sea is more favorable than the Tatar Strait, it has a large matured flounder population, and there are more canneries than in the region of the Tatar Strait.

Table VI is based on observations taken over a number of years. It shows that *Limanda aspera* is the main species in the Tatar Strait and in Kamchatka and represents approximately 59 per cent of the total catch of flounders.

The table also indicates that, because of a more intensified fishing for this species in Peter the Great Bay, its average weight is only 250 grams against 420 grams in the Kamchatka area where fishing is not so intensified and where matured flounders are abundant. Both the table and the Soviet press suggest that the younger stock of this species and flounders in general are caught in Peter the Great Bay in a greater percentage than in Western Kamchatka. Available data point out that in 1939 over 37 per cent of the catch of fisheries located in Peter the Great Bay was young stock which was too small for commercial processing. The average weight of all species based on observations over a number of years varied from 252 grams in Peter the Great Bay and 390 grams in the Tatar Strait to 560 grams in the Western Kamchatka. It is also interesting to note that flounders reach full maturity in the fourth year of their lives when they attain 24–26 centimeters in length. Another interesting point is that in processing flounders into fillets, there is a loss of 63–78 per cent of the live weight. Bones account for up to 20 per cent of the total loss, internal organs, 45 per cent, and skin up to 12 per cent. It seems likely that Kamchatka with its large population of matured flounders will become a major canning region in the Soviet Far East.

Almost all species belonging to the subfamily *Pleuronectini* (*Pleuronectes quadrituberculatus*, *Limanda aspera*, *Limanda herzensteini*, *Liopsetta obscura*, *Limanda yokohamae*, *Lepidopsetta bilineata mochigerei*, *Liopsetta pinnifasciata*, *Liopsetta glacialis*, etc.) have fine meat, keep well in storage, have no unpleasant smell, and lack mucus. Members of subfamily *Hippoglossini* (*Gleisthenes herzensteini*, *Acanthopsetta nadezhnyi*, and *Glyptocephalus stelleri*), however, are not as good as the above-mentioned species and have a peculiar smell, a tendency to rapid deterioration, and mucus on the body, but these species are not important in Kamchatka.

POTENTIAL AVAILABILITY OF FLOUNDERS IN THE SOVIET FAR EAST

Potential resources of flounders in the Soviet Far East are many times greater than the present landing.

The future area for an expansion in catching of flounders in the Soviet Far East lies in the waters of Kamchatka, the Tatar Strait, and southern Sakhalin Island. These waters have the greatest concentration of flounders and only recently were tapped by commercial fisheries. Waters of Peter the Great Bay have already been exploited for a num-

TABLE VI

PERCENTAGE OF THE TOTAL CATCH AND THE AVERAGE WEIGHT

(After P. A. Moiseeff, pp. 47 and 49)

Species	Western Kamchatka		Peter the Great Bay		Tatar Strait	
	Per cent	Weight (grams)	Per cent	Weight (grams)	Per cent	Weight (grams)
Limanda aspera	60	420	26	250	90	350
Pleuronectes quadrituberculatus	20	1,000	..	...	2	550
Limanda herzensteini	..	.....	15	290	..	...
Limanda proboscidea punctatissima	8	.....	7	240	..	...
Cleisthenes herzensteini	..	.....	40	280	..	...
Hippoglossoides elassodon dubius	4	.....	2	330	4	330
Lepidopsetta bilineata mochigerei	3	900	4	...	..	...
All others	5	.....	6	...	4	...

ber of years and as Table I shows even in 1944 the output was drastically reduced. The potential output of this region is estimated at 3500 metric tons (Table VII). No doubt the Soviet government will impose restrictive measures on catching flounders in these waters. The Kuril Islands under Japanese management depleted their flounder population; here the potential annual output is estimated at 5000 metric tons.

TABLE VII

ESTIMATED POTENTIAL CATCH OF FLOUNDERS IN THE FAR EAST

(After P. A. Moiseeff, p. 55)

Region	*Metric tons*	
Sea of Japan:		
Tatar Strait	12,000	
Southern Sakhalin Island	10,000	
Peter the Great Bay	3,500	
Northern Maritime regions	2,000	
Preobrozhensk Bight	700	
Olga-Vladimir bights	400	
Rynda Bight	400	
Subtotal		29,000
Sea of Okhotsk:		
Southwestern Kamchatka	25,000	
Northwestern Kamchatka	20,000	
Midwestern Kamchatka	15,000	
Kuril Islands	5,000	
Southeastern Kamchatka	2,000	
Avachinsk Bight	1,000	
Subtotal		68,000
Total Soviet Far East		97,000

The estimated potential catch of flounders is possible only if the Soviet government is willing and able to build larger trawlers which can reach the winter beds, new canneries to process the increased raw material, and new factory-ships and new refrigerator-ships especially if the catch of flounders is to be increased in the Tatar Strait which lacks large canning and storage facilities. It is not probable that the Soviet government can increase fishing facilities in the Far East at present. The 1946–1950 plan provides for construction of 150 new trawlers, 13 new canneries, 30 new refrigerator-ships, and several new factory-ships, but these are to replace old, worn-out equipment and equipment destroyed in the War. They are for use in the western parts of the Soviet Union, which now intends to expand its deep-sea fishing. In 1950, according to this plan, the total Soviet catch of fish is to be 50 per cent greater than the prewar output, but the plan for the Far Eastern fisheries calls for an increase of 35 per cent of their prewar production, which suggests that the stress is not so much in the regions of the Far East as in the European parts of the Soviet Union. This increase in the European parts of the Soviet Union, however, must be considered with reservation for the Baltic States which now produce fish products for the Soviet Union were not occupied by the Soviets until 1940.

If we assume that this percentage (35) is applicable to all fish, including flounders, then the Far Eastern fisheries even in 1945 overreached the amount of flounders they landed in 1940 by seven times. This also indicates that whatever increase in 1950 will take place in the Far Eastern fisheries, the flounder's share in this increase will be substantially larger than for other fish, which means that in 1950 Russians will eat more flounders.

In 1947, fisheries of Sakhalin and the Kuril Islands pledged to have 800 fishing motorboats, 930 large weirs, and 12 fishing combines. Fishermen of these islands pledged to produce 4098 metric tons of fish.[3] How much of this is to be allocated to flounders is difficult to estimate, but it should not be more than 10 per cent of the total catch. And considering the large flounder population there should be no doubt that any expansion in fishing facilities will increase the total catch of flounders in a greater proportion than the additional investment in the fishing industry.

[3] *Izvestia*, April 12, 1947.

One of the considerations which is important in increasing the total catch in Kamchatka is the fact that until 1947 fishing in Kamchatka was a seasonal occupation, and only in 1947 were fisheries in this region put on a year-around basis, which of course includes landing of flounders in their winter beds.[4] Another factor which may be included as a reason for possible increase in the Far Eastern catch is the fact that before World War II Maritime fishermen used to wait until the schools appeared close to the shores; now an airplane scouts the sea and reports the approaching schools, and the fishing fleet intercepts them before they reach the shallow waters. It is because of this deep-sea fishing that the average landing has increased considerably. In 1946–1947 an average catch of fish per seiner in the Maritime region was 1000–1200 metric tons and in 1949 it was expected to be 1500–2000 metric tons.[5] In 1949, according to the Minister of the Fisheries, A. A. Ishakoff, the Far Eastern fishing fleet not only will start deep-sea fishing but will have a refrigerator-ship which will collect the fish from seiners instead of unloading the catch at the base each time the seiner reached its capacity.[6] Still another factor which will increase the total landing of fish is the fact that the Orochi tribesmen, who previously were unorganized independent fishermen, are now organized into fishing collective farms and no doubt will expand their usual catch.[7]

[4] *Pravda*, October 7, 1947.
[5] *Trud*, July 1, 1949.
[6] *Izvestia*, February 24, 1949.

SUMMARY

In general, whatever increase in catch may be effected in the Soviet Far East in 1950, a large percentage of it may be attributed to a more efficient use of the existing fishing facilities and labor and, even more, to additional fishing waters obtained from Japan. Planned increase for the Soviet Far East in 1950 calls for 35 per cent over the pre-war level. In 1941 the Far Eastern sea waters planned to land 200,400 metric tons of fish and sea animals which was approximately 12 per cent of the total U.S.S.R. planned catch.[8] According to these data, in 1950 the Far Eastern sea waters should land approximately 270,500 metric tons of fish and sea animals, of which about 27,000 metric tons or 10 per cent of the total Far Eastern sea waters should be flounders. Considering the amount of flounders caught in 1945, this goal is not impossible to attain.

[7] *Op. cit.*, August 22, 1948.
[8] "Gosudarstvennyi Plan Rasvitia Narodnago Khozaistva S.S.S.R. na 1941 God," Moscow, 1941, p. 724.

AFRICAN COFFEE ON KILIMANJARO: A CHAGGA *KIHAMBA*

Edwin S. Munger

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IN Tanganyika Territory, just south of its common border with Kenya Colony, Hassan Marealle owns an average size *kihamba* (farm) 3500 feet up the south slope of Africa's highest mountain, Kilimanjaro. He grows bananas for food and coffee for cash. He is prosperous, as are his fellow Chagga tribesmen, and has a high living standard in comparison to most Africans.

The Chagga tribe, 200,000 strong, is one of the most progressive African communities in eastern Africa. On their *vihamba* (farms), which circle the lower slopes of this 19,560 foot, equatorial, snow-capped mountain, the Chagga have been able to produce a cash crop for the western world without destroying their African social structure and system of land tenure.

In addition to his 3.7 acre *kihamba*, Marealle has a 4.2 acre *rema* (farmland) four miles down Kilimanjaro's shoulder on the dry plain where he grows maize for his family and for sale in the African market. An acre of beans adds variety to his diet, and an acre of millet makes *pombe* to drink.

Up the mountain side Marealle, like the other Chagga, intertills his coffee with bananas to furnish the necessary shade from the equatorial sun. The bananas are picked year-round, but coffee is a one-season crop. He prunes his *arabica* coffee trees during the first two months of the year, sprays them in March, and picks the red berries from late August until December. His 560 trees yield seven bags of first-grade coffee, running 112 pounds to the bag, for which he receives the East African sterling equivalent of $.10 a pound. Of this, $.08 is paid immediately and $.02 when the crop is resold by the Kilimanjaro Native Cooperative Union (K.N.C.U.), which markets the whole Chagga crop. The coffee is cured in nearby Moshi before being sent to the port of Mombasa in Kenya, from where it is normally shipped to England.

Marealle's family does most of the agricultural work, though an extra man is hired for about ten days a year to help prune at the rate of what equals $.005 a tree. Spray and the jute bags in which the coffee is shipped are supplied free by the K.N.C.U., but Marealle has to buy the *jembes* (hoes) for digging and scissors for pruning.

Only a Chagga would be permitted to buy or inherit Marealle's land. When he dies, it will be divided, according to custom, between the eldest and youngest sons. Tradition holds that the oldest son, having benefited from parental attention over a longer period of time, should leave the family homestead to his youngest brother, who most needs a start in life. Until recently tribal holdings were sufficient to allow chiefs to allot new land (after the gift of a bull) to young Chagga requiring it. Alienation has thus been avoided and land tenure stabilized. Of late, however,

fragmentation has arisen as land has become scarcer. The Chagga are expanding up the mountain but are eventually stopped by cold or by Tanganyika government regulations protecting the forests. Down the mountain the climate becomes too dry for coffee. Temporary alleviation may come when the Custodian of Enemy Property (German mainly) disposes of fairly large holdings. The Chagga want the land. They think it should be given to them outright but realize this is a remote possibility. If the price is beyond what the tribe can raise, they are ready to demand that the government lend them the necessary funds, to be repaid slowly.

Marealle is one of 30,000 members of the Kilimanjaro Native Cooperative Union with assets over £15,000. The coffee industry really began fifty-odd years ago when a Catholic missionary introduced coffee to Kilimanjaro. By 1920, there were over 16,000 trees. As planting increased and more Chagga began growing coffee, firms dominated by Indian immigrants sprang up to buy, cure, and sell the crop. The Chagga came to resent exclusion from all but the growing side of the flourishing industry and in 1925 formed the Kilimanjaro Coffee Planters Association, later absorbed when the K.N.C.U. was started in 1932 to advise and to buy and market their coffee overseas. So many of the Chagga growers joined the new African-run cooperative that it was able to begin buying out the Indian middlemen, who have now disappeared from the industry.

From the beginning, a Chagga has been elected president of the cooperative. Realizing their technical and administrative inexperience, though, they employed British people to work for them, while retaining firm control. Increasing organizational complexity might mean having to introduce more outsiders and possibly losing control. The Chagga have foreseen this danger and, by collecting funds, have sent some of their own people abroad for education that will enable them to handle the difficult jobs.

While the Chagga have shown remarkable initiative and energy, they have also been fortunate in having had the help of two exceptional British officials. Many parts of East Africa bear evidence of the practical wisdom of Charles Dundas (later Governor of Tanganyika), but his conviction when he was a young District Commissioner at Kilimanjaro that the Chagga would benefit from intensive and careful cultivation of coffee has led to outstanding results. A. L. B. Bennett stayed with the tribe for over fourteen years nursing along the cooperative, holding the confidence of the Africans through periods of low prices, disease, and dissension. Not only did he carry the administrative load in the early years, but—even more important a contribution—he trained Chagga to manage their own affairs.

Kilimanjaro's deep, rich, volcanic soil and snow-fed streams are the prized resources of the tribe. Even before Marealle's great-uncle personally greeted the first European explorer to Kilimanjaro, the people were damming the cold, crystalline water to irrigate their *vihamba*. Added to these physical resources are the improvements of scientists at Lyamungu Coffee Research Station nearby, where methodical selection of the most prolific clones has led to greatly increased yields. The government runs the station to help both Chagga and nearby European planters.

Introduction of improved methods and general supervision of cultivation, pruning, cleaning, etc., require a measure of authority backed by force. When the Chagga began growing coffee, German and British planters objected strenu-

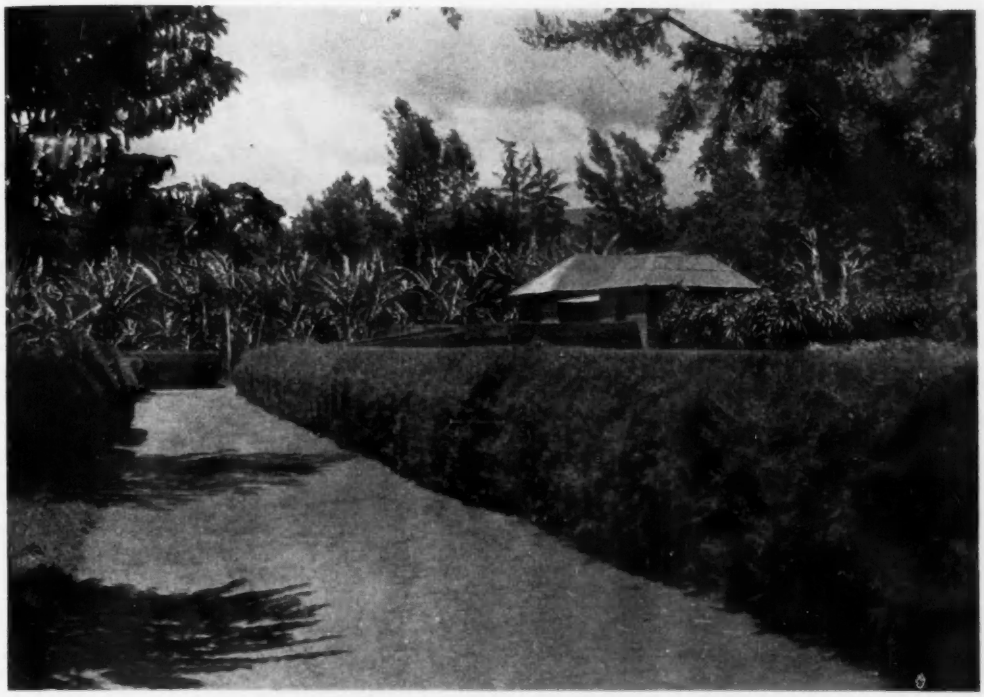

FIG. 1. The lane leading to the cement block house is bordered by a neat hedge.
FIG. 2. Marealle standing among coffee bushes in the shade of banana fronds.

FIG. 3. The family Marealle in front of their comfortable iron-roofed home.
FIG. 4. Behind the house the coffee berries are sorted and dried.

ously, claiming that poor care would ruin the African crop and eventually spread *arabica* diseases to their own plantations. K.N.C.U. disproved this fear but went through bitter times. It took all the influence the chiefs could muster to carry out some of the necessary regulations. The Tanganyika government wisely relieved the cooperative and the chiefs of this odious police function and turned it over to the Moshi Native Coffee Board, of which three of its six members are Chagga and their old friend Bennett the executive head.

One of the thorniest problems of East Africa is: What African cash crops of high enough value to support transport to distant markets can be grown? European- and Asian-owned plantations have been successful with a number of monocultures—tea, coffee, sisal, pyrethrum, among others—but with capital, know-how, machinery, and large tracts of land. Africans lack these. The Baganda in the Uganda Protectorate to the north have found cotton a way out of this dilemma, but Kenya and Tanganyika are climatically unsuited for cotton.

For the Chagga, "peasant coffee" is an admirable solution. Their 3000 tons a year is only 0.2 per cent of world production, but to the 200,000 Chagga people it means approximately £20,000 —a big step up from bare subsistence. The strength of their cooperative movement comes from a wide, healthy base of peasant producers like Marealle, from a tribal discipline, and from wise leadership, both British and African.

BOOK REVIEWS

Marketing Maps of the United States—An Annotated List, by Walter W. Ristow. 52 pp.; subject index. The Library of Congress, Washington, D.C., 1951. 40¢. 10¼ x 8 inches.

This reference list of marketing maps published during the last two decades should prove of interest to geographers and marketing researchers. To the geographer the publication calls attention to the growing interest in marketing maps and in marketing geography. The marketing researcher will find this reference list useful in his studies of marketing problems.

The work is a first attempt of its kind. The compiler points out its limitations: it is not complete; it includes only maps "prepared for, or in connection with, marketing studies"; and it is limited to maps which "cover the entire United States or a major part of the country"—maps of single market centers are not included.

A total of 240 items are listed. Of these 21 are so-called marketing atlases. All items are arranged alphabetically by author or publishing authority, and are numbered. Brief annotations are given to aid prospective users. A subject index cross-references the 240 items as 430 entries under 60 different subjects. Four-fifths of these entries are listed under the fifteen leading subjects; nearly half of the entries (45 per cent) are listed under five subjects: Trading Areas 51, Retail Sales 44, Trading Centers 43, Chain Stores 27, Farm Markets 25.

The 240 items listed were published by 73 different sources, as follows:

Source	*Number*	*Maps and Atlases*
Magazine Publishers.....	29	154
Advertising Agencies.....	14	15
Broadcasting Companies...	4	17
Map Publishers.....	3	21
Miscellaneous Business....	19	25
U. S. Government Agencies	4	8
TOTAL.....	73	240

It is regrettable that the compiler resisted the temptation to evaluate the cartographic attributes of these maps. The majority are mediocre products—157 have no scale, are not to scale, or are of the intentionally distorted variety. Geographers will be well-advised to study some of these maps. This should encourage them to demonstrate how much better they could do.

The compiler defines a marketing map as a geographic representation of marketing and distribution data on a base map. Why not a cartographic representation of marketing data *of an area?*

The reviewer would like to urge Dr. Ristow to undertake an enlarged and revised second edition, with an improved index and a more complete introductory statement concerning the genesis, characteristics, and purposes served by these marketing maps of the United States.

WILLIAM APPLEBAUM

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Industrial Plant Location, Its Application to Zinc Smelting, by CARL H. COTTERILL. vi and 155 pp.; maps, illustrations, bibliogr. Published through courtesy of Amer. Smelting and Refining Co., St. Louis, 1951. Ltd. edition, available from the author, 1600 Paul Brown Bldg., St. Louis. $5.00. 9¼ x 6 inches.

Dr. Cotterill's thesis on the zinc smelting industry is an important contribution to the field of industrial geography. The significance of this work lies not only in a hitherto unavailable analysis of the production and location patterns of the zinc industry, but even more so in its application of recognized locational principles to the problem of plant location in a specific industry.

Following a short introduction the author divides his study into three main parts: the zinc industry, the locational factors, and the case study. The first section discusses such topics as raw materials, production and consumption patterns, and trends in the industry and the technology and logistics of zinc smelting. In his discussion of the pattern of the zinc industry Cotterill emphasizes its position as a producer of basic goods; one in which there is a heavy investment in fixed assets in relation to net income from sales. He ascribes to this factor the survival of some uneconomic producers and the concentration of economic control in the hands of a few large companies. Thus out of a total of 13 firms in the industry, four hold over 80 per cent of the slab zinc capacity of the nation. The author's analysis of the ore supply

problem stresses the shift that has taken place in the last 20 years. At that time this country produced practically all of its requirements of zinc ore, but by 1945 it was necessary to import more than two-fifths of our needs. Another change which is emphasized has been the general shift from the utilization of low to high quality slab zinc. The author ascribes this shift to the gradual replacement of low grade zinc in the production of cartridge brass and the rapidly increasing consumption of the higher quality product in the die casting industry. The discussion of the technology and logistics of zinc smelting is excellent and clearly illustrated by a number of diagrams and photographs. Here the exact material requirements for the production of slab zinc and the by-product results of the process are described in greater detail.

The second section of this study begins with an analysis of the general factors in industrial location based largely on Weber's approach to the problem. Then these general principles are applied to the problem of plant location in the zinc industry. In his analysis Cotterill discusses the quantitative requirements for the production of slab zinc at a stereotype zinc smelter, sources and costs of materials by area, and transportation costs for the assembly of raw materials at the smelter as well as for the shipment of slab zinc from established producing points to common market points.

The last important factor considered is labor, and this discussion is logically based on a regional evaluation of average labor costs per ton of slab zinc. Finally, all of these factors are evaluated and analyzed to determine what Cotterill calls the "controlling" and "modifying" factors with the conclusion that raw materials, labor, and fuel are controlling, with by-product utilization as an important modifying factor. Then all present zinc smelter locations are analyzed to determine the validity of these assumptions.

In part three those factors which were deemed critical from the previous analysis are utilized in a case study of two smelters. Here the author has attempted to determine the variations in actual costs attributable to location. His results indicate that geographic advantages are reflected in costs of production, and that the utilization of by-products may mean the difference between success and failure of certain plants.

The book is accompanied by many fine charts, diagrams, and photographs. The maps that are included in the study are praiseworthy since the study was not made by a geographer and maps are rare in many economic studies. However, from a technical viewpoint the maps themselves are rather crude, and very often the scale of the various bars and circles used to illustrate qualitative and quantitative data is unclear.

This study is especially significant because the author has embarked with considerable success upon a field in which the geographer can play an important role. Yet, it is one in which the geographer's contribution has not been of major importance. Economists have studied the problem of industrial location since before the turn of the century. Theoretical studies by Weber, Palander, and Lösch, to mention the more outstanding, have received wide attention in this country and have influenced the thinking and writings of many American scholars. Yet the application of their theoretical analyses to the problems of industrial plant location in specific industries has been badly neglected. Such studies as Hoover's "Location Theory and the Shoe and Leather Industry" and Hartshorne's "Location Factors in the Iron and Steel Industry" have been extremely rare. It is here, then, in the application of this vast background of theory to actual problems of plant location that the geographer can perform a useful function. It is to be hoped that studies like Cotterill's will be more frequent in the future, and that many of them will be undertaken by geographers.

ALLAN RODGERS

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Land Problems and Policies. Edited by JOHN F. TIMMONS and WILLIAM G. MURRAY. viii and 298 pp.: maps, charts, bibliogr., index. The Iowa State College Press, Ames, Iowa, 1950. $4.00. 9¼ x 6¼ inches.

This book is a series of fifteen essays, the greater number of which were initially offered as papers given at a Land Economics Institute held at Iowa State College in 1949. The editors of the volume, professors of agricultural economics at Iowa State, have thereby succeeded in attracting a number of prominent contributors from both academic and government life to review aspects of our national land program. The result is the best over-all summary of national land resources policies in the rural setting that has appeared since the war, though unfortunately, and despite the advantages of a seminar, the correlation and integration of the essays was not entirely successful. The book's preoccupation with rural land policies and programs can be attributed to the background of the contributors who with a few exceptions can be classified as agricultural economists or soil scientists.

The editors have tried to overcome some of the disparities in the articles by building a logical sequence out of the essays. The first article, by Rainer Schickele on the "Objectives of Land Policy," does serve as an excellent focus for the book. Schickele recognizes that land policies must be formulated in terms of their

contribution to the nation's "maximum social product" and not in terms of agricultural groups or sections alone. But the geographer or the political scientist will not wholly appreciate the emphasis he gives to the economic concepts of marginal theory and optimum income distribution in his analysis. The two following essays, by Warren Thomsen and co-authors Charles Kellogg and Carleton Barnes, are designed to bring into perspective population trends and available land resources. The population assessments, however, are in terms of world population trends, while the analysis of farm land resources is based entirely upon the situation in the United States so that the statistics are not comparable.

The next seven essays deal with various aspects of land use. Sherman Johnson deals with the "Principles of Land Utilization," H. H. Bennett with the "Use and Conservation of Our Farm Lands," R. R. Renne with "Range Land Problems and Policies," Marion Clawson with the "Use and Control of Water Resources," J. D. B. Harrison with "Forestry in a Changing World," Ernest Griffith with "Recreational Land Problems and Policies," and Ira Gabrielson with the "Problems and Policies of Wildlife Management." The article on forestry excepted, the essays in this section are primarily devoted to the national scene. On the whole these authors recognize the problems and conflicts of policy resulting from competing land uses, and particularly in the Clawson, Griffith, and Gabrielson chapters the principle of multiple development and use of land resources is stressed. These essays in total, however, do not add up to a critical review of the existing land resources programs, nor is any clear picture given of the circumstances under which a particular land use should predominate. Several of these authors do refer to needed organizational reforms proposed by the Task Force on Natural Resources of the Hoover Commission, but only Gabrielson goes so far as to indict individual agencies, particularly the Department of Agriculture which he maintains is "galloping wildly in all directions" in its farm programs.

The last group of essays in the volume deals with specific land policies that should be developed and the instruments and measures whereby they might be achieved. Joseph Ackerman in "Family Farm Problems and Policies" supports a program that will foster the ideal of the family farm. Raymond Penn in "Public Interest in Private Land" discusses the feasibility of methods which permit society to control the pattern of land use. V. Webster Johnson in "Planning the Use of Land Resources" outlines the steps in the land-planning process and reviews briefly the accomplishments of the national government to this end. O. B. Jesness in "Land Programs in a Policy Framework" argues for less piece-meal land-programming and more over-all policy coordination. Editor Timmons in the last chapter, "Building a Land Policy," calls upon the states and the national government to create Land Policy Commissions and in addition proposes the creation of a Natural Resources Council in the Office of the President to make final policy determinations concerning land as well as other resource uses.

The underlying theme which holds this book together is the general recognition of the need for the conservation of the nation's land resources. Compared to the Proceedings of the National Conference on Land Utilization in 1931 this volume is also a reflection that our thinking on this subject is much more sophisticated than it was two decades ago. One wishes, however, that this work might have made a more systematic review of land policies associated with commerce and industrialization in conjunction with those of agriculture. Furthermore, a more careful analysis of the conflicts between state and regional land use goals versus those of the national would have been desirable. On the whole the book is well edited and to each of the chapters a selected bibliography is appended.

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